GENCOR INDUSTRIES INC.
5201 N. Orange Blossom Trail • Orlando, Florida 32810
(407) 290-6000 • FAX (407) 578-0577

Mr. Richard DeFelice
Newport Materials
145 Temple St.
Nashua, NH 03060

Re: Power Source: Gencor Model 400 TPH Ultra Plant

Dear Mr. DeFelice/Town of Westford

Pursuant to the Town of Westfords request regarding this plants power source, we offer the following clarification.

This equipment will be powered by the use of commercial electric power. Gencor will be providing a complete hot mix facility that will have an energy control center powered by electricity. This control center will contain all of the starters and breakers to run all components of the facility. This control center will arrive completely wired with a main breaker for your local power company to connect to.

Within this hot mix manufacturing process is the Low Nox Electric Powered Air Burner that will provide the needed heat within the dryer drum component to dry the aggregates prior to the mixing process. The electric powered Low Nox Burner will burn natural gas as its primary source.

In the event of a shortage or disruption in natural gas service this burner or equivalent will also have the ability to process ultra-low sulfur number 2 fuel oil as its backup source.

I am pleased to provide any further clarifications as you made need.

Sincerely,

Charles Bartell
Regional Sales Manager
Gencor Industries
Orlando, FL 32779
Cell (407) 718-1661

Affidavit of Keith Harper

1. My name is Keith Harper and I am an electrical engineer in the State of Florida and Chief Controls Engineer at Gencor Industries, Inc., the manufacturer of Newport's 400 TPH Ultraplant.
2. Gencor Industries, Inc. has been selected to provide the hot mix plant to Newport Materials located in Westford, Massachusetts.
3. The 400 TPH Ultraplant to be provided will be powered entirely by commercial electricity supplied by a local commercial power utility. The plant will arrive with a completely pre-wired power control center with a main electric breaker that connects to the commercial power source.
4. The control center will disperse the electricity to the various components i.e.; the conveyor belts, the HVAC system, the exhaust system and the fuel pump systems. The plant will also utilize an Ultra Low NOx total air burner. The combustion burner is powered by electricity and utilizes Natural Gas as its primary fuel. The burner will provide the hot air needed to heat the aggregates prior to entering the mixing section of the drum. As a backup to the Natural Gas, the burner will have the capability to burn low-sulfur #2 oil, should an interruption of Natural Gas service occur.

Signed this 28th day of January 2015.

Keith Harper

State of Florida
County of Orange

✓ Personally Known

(Signature of Notary)

JAMES COOK
Notary Public - State of Florida
My Comm. Expires Jul 14, 2015
Commission # EE 112531

(Name of Notary Typed, Stamped, or Printed)
Notary Public, State of Florida

TRANSPORTATION IMPACT ASSESSMENT

PROPOSED BITUMINOUS CONCRETE MANUFACTURING FACILITY
WESTFORD, MASSACHUSETTS

Prepared for:

NEWPORT MATERIALS, LLC and 540 GROTON ROAD LLC
Nashua, New Hampshire

February 2015

Prepared by:

VANASSE & ASSOCIATES, INC.
35 New England Business Center Drive
Suite 140
Andover, MA 01810
(978) 474-8800
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EXECUTIVE SUMMARY

Vanasse & Associates, Inc. (VAI) has conducted a Transportation Impact Assessment (TIA) in order to determine the potential impacts on the transportation infrastructure associated with the proposed construction of a bituminous concrete manufacturing facility to be located at 540 Groton Road (Route 40) in Westford, Massachusetts (hereafter referred to as the "Project"). Pursuant to the stipulations contained in the Remand Decision of the Land Court concerning the Project,[1] Project-related traffic will be restricted to no more than 250 vehicle trips per diem.[2] At present, the Project site consists of previously disturbed areas resulting from the on-going use of the property in its entirety for multiple industrial and commercial uses.

Access to the Project site will be provided by way of the existing driveway that serves 540 Groton Road which will be improved in conjunction with the Project. All trucks, excepting local deliveries of bituminous concrete product, will be directed to exit to the east and to use the Route 3/Groton Road (Route 40) interchange (Exit 33). This is consistent with the current restriction for exiting truck traffic at the Project site driveway (signs indicating "No Right Turn", "Left Turn Only" and "All Trucks Must Turn Left" are posted for vehicles exiting the driveway that will serve the Project). Parking will be provided within the Project site for four (4) vehicles, including one (1) handicapped accessible space.

This study was prepared in consultation with the Towns of Westford and Chelmsford, and the Massachusetts Department of Transportation (MassDOT); was performed in general accordance with MassDOT's *Transportation Impact Assessment (TIA) Guidelines,* the Town of Westford's *Guidelines for Preparation of a Transportation Impact Assessment* (as revised through January 18, 2006) and the applicable sections of Section 9.3A, *Special Permit Performance Standards for Major Commercial Projects and Major Retail Projects*, of the Town of Westford Zoning By-Law; and was conducted pursuant to the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports.

[1]Commonwealth of Massachusetts Land Court, Department of the Trial Court, 10 MISC 429867 (AHS); December 8, 2014.

[2]A vehicle trip constitutes a two-way movement which, by definition and extension to the Project, limits the volume of traffic generated by the Project as measured at Groton Road to 125 vehicles entering and 125 vehicles exiting per day.

As a result of this assessment, we have concluded the following with respect to the Project (a bituminous concrete manufacturing facility restricted to no more than 250 vehicle trips per diem):

1. The Project is expected to generate approximately 250 vehicle trips on an average weekday and Saturday (125 vehicles entering and 125 exiting), with approximately 37 vehicle trips expected during the weekday morning peak-hour, 25 vehicle trips during the weekday evening peak-hour and 24 vehicle trips during the Saturday midday peak-hour;

2. The Project will not have a significant impact (increase) on motorist delays or vehicle queuing over Existing or anticipated future conditions without the Project (No-Build conditions), with no material impact on the flow of traffic along Groton Road shown to occur as a result of the Project;

3. No apparent safety deficiencies were noted with respect to the motor vehicle crash history at the Groton Road/Commerce Way intersection. The Groton Road/Oak Hill Road intersection was found to have a motor vehicle crash rate above the MassDOT averages for an unsignalized intersection. Improvements are planned at this intersection by others that include geometric modifications and the installation of a traffic control signal, measures which will help to reduce the frequency of occurrence of angle-type collisions at the intersection (the predominant crash type reported); and

4. Lines of sight to and from the Groton Road/Commerce Way intersection were found to exceed the required minimum distance for the intersection to function in a safe and efficient manner based on a 45 mile per hour (mph) approach speed along Groton Road, consistent with the measured 85th percentile vehicle travel speed (41 mph) and 10 mph above the posted speed limit (35 mph).

In consideration of the above, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with implementation of specific recommendations defined herein.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in January and February 2015. The field investigation consisted of an inventory of existing roadway geometrics; pedestrian and bicycle facilities; public transportation services; traffic volumes; and operating characteristics; as well as posted speed limits and land use information within the study area. The study area for the Project was selected to contain the major roadway providing access to the Project site, Groton Road (Route 40), as well as the intersections of Groton Road at Commerce Way (the driveway to 540 Groton Road) and Groton Road at Oak Hill Road. This study area is consistent with that which was previously evaluated for the Project and is reflective of the relatively low volume of traffic that is expected to be generated by the facility (not to exceed 250 vehicle trips per day).

Existing Traffic Volumes

In order to determine existing traffic-volume demands and flow patterns within the study area, automatic traffic recorder (ATR) counts, manual turning movement counts (TMCs) and vehicle classification counts were completed in January and February 2015 while public schools were in regular session. The ATR counts were conducted on Groton Road in the vicinity of Commerce Way in order to record weekday daily traffic conditions over an extended period, with weekday morning (7:00 to 9:00 AM), weekday evening (4:00 to 6:00 PM) and Saturday midday (11:00 AM to 2:00 PM) peak period manual TMCs performed at the study intersections. These time periods were selected for analysis purposes as they are representative of the peak traffic volume hours for both the Project and the adjacent roadway network. The January and February traffic volumes were found to be representative of below average-month conditions and, therefore, were adjusted upward accordingly in order to represent traffic volumes under average-month conditions in accordance with MassDOT standards. The following summarizes existing traffic volumes along Groton Road:

Groton Road:

Average Weekday Traffic: 13,705 vehicles[3]
Weekday Morning Peak Hour (8:00 – 9:00 AM): 1,099 vph[4]
Weekday Evening Peak-Hour (5:00 – 6:00 PM): 1,174 vph
Saturday: 11,355 vehicles
Saturday Midday Peak-Hour (12:00 – 1:00 PM): 946 vph

Recognizing that activities associated with the existing operations within the larger property that contains the Project site were limited during the traffic count period (January), the turning movement data for vehicles entering and exiting Commerce Way was adjusted upward by 50 percent in order to represent traffic volumes under peak construction season conditions (June through September).

Pedestrian and Bicycle Facilities

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in January 2015. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. Sidewalks are not currently provided along Groton Road within the study area. A marked crosswalk is provided for crossing the Groton Road west leg of the Groton Road/Oak Hill Road intersection that includes accompanying pedestrian crossing warning signs, and a sidewalk is provided along the west side of Oak Hill Road south of Groton Road.

Formal bicycle facilities were not identified within the study area; however, portions of Groton Road appear to provide sufficient width (combined travel lane and shoulder) to support bicycle travel in a shared travelled-way configuration.[5]

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[3] Two-way, 24-hour volume.

[4] Vehicles per hour (vph).

[5] A minimum combined travel lane and paved shoulder width of 14-feet is required to support bicycle travel in a shared travelled-way condition.

Public Transportation

Public transportation services are currently not available within the immediate study area; however, the Lowell Regional Transit Authority (LRTA) does provide fixed-route bus service to the Town of Westford. LRTA Bus Route 15, *Chelmsford/Westford via Routes 129/110*, provides bus service along Route 110 to the south of the Project site and the study area. In addition, LRTA Bus Route 17, *North Chelmsford via Middlesex*, provides bus service along Groton Road within the Town of Chelmsford, with the closest stop to the Project site located at the Triangle Store (intersection of Groton Road at Main Street), northeast of the Route 3/Groton Road interchange.

Spot Speed Measurements

Vehicle travel speed measurements were performed on Groton Road in the vicinity of Commerce Way over a 72-hour period (Thursday through Saturday) in conjunction with the ATR counts. Based on these measurements, the mean (average) vehicle travel speed along Groton Road in the vicinity of Commerce Way was found to be approximately 37 mph. The average measured 85th percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be approximately 42 mph, which is 7 mph above the posted speed limit (35 mph). The 85th percentile speed is used as the basis of engineering design and in the evaluation of sight distances, and is often used in establishing posted speed limits.

Motor Vehicle Crash Data

Motor vehicle crash information for the study intersections was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent five-year period available (2008 through 2012, inclusive) in order to examine motor vehicle crash trends occurring within the study area. Based on a review of the MassDOT data, the study area intersections were found to have experienced an average of five (5) or fewer reported motor vehicle crashes per year over the five-year review period, the majority of which involved property damage only, occurred on a weekday and were reported as angle-type collisions. The Groton Road/Commerce Way intersection was found to have a motor vehicle crash rate below both the MassDOT statewide and District averages for an unsignalized intersection for the MassDOT Highway Division District in which the intersection is located (District 3).

The Groton Road/Oak Hill Road intersection was found to have a motor vehicle crash rate above both the MassDOT statewide and District 3 averages for an unsignalized intersection, with one (1) fatal motor vehicle crash reported to have occurred at the intersection within the five-year review period. The fatal motor vehicle crash was reported as an angle-type collision and occurred on Sunday, September 16, 2012 at approximately 3:00 PM under clear weather conditions. The Groton Road/Oak Hill Road intersection was also ranked 98th on the top 100 high crash intersections for 2006-2008 in the Northern Middlesex Region.[6] Improvements are planned at the intersection that include geometric modifications and the installation of a traffic control signal, measures which will help to reduce the frequency of occurrence of angle-type collisions at the intersection (the predominant crash type reported).

[6]The Top 100 High Crash Intersections in the Northern Middlesex Region, 2006-2008; Northern Middlesex Council of Governments.

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2022, which reflects a seven-year planning horizon consistent with MassDOT's *Transportation Impact Assessment (TIA) Guidelines*. Independent of the Project, traffic volumes on the roadway network in the year 2022 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated Project-generated traffic volumes superimposed upon the 2022 No-Build traffic volumes reflect 2022 Build traffic volume conditions with the Project.

Specific Development by Others

The Planning Departments of the Towns of Westford and Chelmsford were contacted in order to determine if there were any projects planned within the study area that would have an impact on future traffic volumes at the study intersections. Based on these discussions, the following project was identified for inclusion in this assessment:

- ***Spaulding Hill Estates, Westford, Massachusetts.*** This project will entail the construction of a 32-lot residential subdivision to be located along the north side of Groton Road, between Dunstable Road and St. Augustine Drive (west of the Project site), in Westford, Massachusetts. Traffic volumes associated with this development were estimated using trip-generation statistics published by the Institute of Transportation Engineers (ITE)[7] for the appropriate land use and were assigned onto the study area roadway network based on existing traffic patterns.

No other developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the general background traffic growth rate.

General Background Traffic Growth

Traffic-volume data compiled by MassDOT and the Northern Middlesex Council of Governments (NMCOG) from permanent count stations and historic traffic counts in the area were reviewed in order to determine general background traffic growth trends. Based on a review of this data, it was determined that traffic volumes along Groton Road as measured in Chelmsford at the Westford Town Line between 2003 and 2012 have generally increased by approximately 1.45 percent per year.[8] In order to provide a conservative (high) analysis scenario and a prudent planning condition for the Project, a slightly higher than average 1.5 percent per year compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Roadway Improvement Projects

MassDOT and the Towns of Westford and Chelmsford were contacted in order to determine if there were any planned roadway improvement projects expected to be completed within the study area. Based on these discussions, the following roadway improvement project was identified for review in conjunction with this assessment:

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[7] *Trip Generation*, 9th Edition; Institute of Transportation Engineers; Washington, DC; 2012.

[8] *2013 Northern Middlesex Region Traffic Volume Report*; Northern Middlesex Council of Governments; 2013.

- ***Groton Road/Oak Hill Road Intersection Improvement Project, Westford, Massachusetts.*** This intersection improvement project will entail the reconstruction of the intersection of Groton Road at Oak Hill Road to include geometric modifications, drainage improvements, pedestrian and bicycle accommodations, and the installation of a traffic control signal in order to improve both traffic operations and safety. These improvements are currently at the conceptual design level and are listed in the Northern Middlesex Metropolitan Planning Organization FFY 2015-2018 Transportation Improvement Program (TIP) list for funding in 2017, within the horizon year of this assessment (2022).

No other roadway improvement projects outside of routine maintenance activities were identified to be planned within the study area at this time.

No-Build Traffic Volumes

The 2022 No-Build condition peak-hour traffic-volumes were developed by applying the 1.5 percent per year compounded annual background traffic growth rate to the 2015 Existing peak-hour traffic volumes and then superimposing the peak-hour traffic volumes associated with the identified specific development project by others.

Project-Generated Traffic

As proposed, the Project will entail construction of a bituminous concrete manufacturing facility which is projected to manufacture an average of 1,500 tons of product per day, and will be restricted to no more than 250 vehicle trips per day as stipulated in the Remand Decision of the Land Court concerning the Project.[9] At least five (5) employees will oversee manufacturing operations.

The manufacture of bituminous concrete product requires two (2) primary components: 1) liquid asphalt (binder); and 2) aggregate (graded stone, sand and Recycled Asphalt Pavement (RAP)). The aggregate component of the mix will consist of both new and recycled materials, with the latter commonly derived from RAP obtained from milling or similar pavement reclaimation activities. It is anticipated that a portion of the non-RAP aggregate required for the Project will be derived from the Fletcher Quarry, the delivery of which will be made by way of trucks traversing roadways internal to the larger property that contains the Project and will not result in additional traffic along Groton Road as a result of the Project.

Based on the information contained in the Remand Order specific to the Project,[10] the following daily trip projections can be derived for the Project with respect to the import of materials to the Project site required in order to produce an average of 1,500 tons of product per day:

- *Liquid asphalt:* 2 trucks per day (4 vehicle trips)
- *RAP:* 13 trucks per day (26 vehicle trips)
- *Imported Aggregate:* 24 trucks per day (48 vehicle trips)
- *Exported Product:* 64 trucks per day (128 vehicle trips)
- *#2 Fuel Oil:* 1 truck per day (2 vehicle trips)
- *Employees (5 employees):* 8 trips per day (16 vehicle trips)

TOTAL: 112 trips (224 vehicle trips)

[9] Ibid 1.
[10] Ibid 1.

It is apparent that the calculated traffic volume projections for the facility (224 vehicle trips per day) are below the 250 daily vehicle trip limitation stipulated for the Project. In order to adjust the calculations to reflect a 250 daily vehicle trip projection while holding the average of 1,500 tons per day materials production, the amount of imported aggregate was increased to 37 truck trips (vs. 24 truck trips) and 74 vehicle trips (vs. 48 vehicle trips).

Peak-hour traffic volume projections for the Project were derived from the daily trip estimates and operational information provided by the Project proponent. In general, approximately 15 percent of the daily truck traffic is expected to occur during the weekday morning peak-hour, with 10 percent expected to occur during the weekday evening and Saturday midday peak hours.

Using the aforementioned methodology and incorporating the 250 vehicle trip per day stipulated limitation for the Project, the Project is predicted to generate approximately 250 vehicle trips on an average weekday and Saturday (two-way volume over the operational day of the Project, or 125 vehicles entering and 125 exiting), with 37 vehicle trips (19 vehicles entering and 18 exiting) expected during the weekday morning peak-hour, 25 vehicle trips (12 vehicles entering and 13 exiting) during the weekday evening peak-hour and 24 vehicle trips (12 vehicles entering and 12 exiting) during the Saturday midday peak-hour.

Trip Distribution and Assignment

Excepting employee trips and local deliveries of bituminous concrete product (anticipated to be less than 5 percent of the traffic generated by the Project), Project-related truck traffic will be directed to exit to the east on Groton Road and will use the Route 3/Groton Road (Route 40) interchange. This is consistent with the current restriction for exiting truck traffic at the Project site driveway (signs indicating "No Right Turn", "Left Turn Only" and "All Trucks Must Turn Left" are posted for vehicles exiting the driveway that will serve the Project). For the purpose of this assessment and to evaluate potential impacts of local deliveries at the Groton Road/Oak Hill Road intersection, it was assumed that 5 percent of Project-related traffic would travel to/from the west on Groton Road, with the remaining 95 percent travelling to/from the east on Groton Road and using the Route 3/Groton Road interchange.

Build Condition Traffic-Volume Networks

The 2022 Build condition traffic volumes consist of the 2022 No-Build traffic volumes with the additional traffic expected to be generated by the Project added to them. The Project was shown to result in peak-hour traffic-volume increases outside of the immediate study area that is the subject of this assessment ranging from 2 to 35 vehicles, with the largest increase occurring on the segment of Groton Road between the Route 3/Groton Road interchange and Commerce Way.

TRAFFIC OPERATIONS ANALYSIS

In order to assess the impact of the Project on the roadway network, traffic operations and vehicle queue analyses were performed at the study intersections under 2015 Existing, 2022 No-Build and 2022 Build conditions. This analysis has indicated that the Project will not have a significant impact (increase) on motorist delays or vehicle queuing over Existing or anticipated future conditions without the Project (No-Build). Critical movements at the Groton Road/Oak Hill Road intersection were shown to operate under constrained operating conditions (defined as a level-of-service (LOS) "F") during the peak hours under 2015 Existing conditions independent of the Project. With the installation of a traffic control signal and associated geometric

improvements as a part of the Town/MassDOT improvement project at the intersection, overall operating conditions at the intersection are predicted to improve to LOS "B" during the peak periods under both 2022 No-Build and Build conditions, where a LOS of "D" or better is generally defined as "acceptable" traffic operations. ***The addition of Project-related traffic to the improved signalized intersection was not shown to result in a change in LOS for any movement at the intersection over the No-Build condition.***

Vehicles exiting Commerce Way (the driveway to 540 Groton Road) at its intersection with Groton Road were shown to operate at LOS "E"/"F" during the weekday morning peak-hour independent of the Project as a result of the relatively large volume of conflicting traffic travelling along Groton Road. With the addition of Project-related traffic, operating conditions for vehicles exiting Commerce Way were shown to degrade from LOS "D" to LOS "E" during the weekday evening peak-hour, and to continue to operate at LOS "F" during the weekday morning peak-hour; however, the resulting vehicle queue along Commerce Way was predicted to range from 2 to 4 vehicles during these peak periods and can be contained along Commerce Way without impeding access or the flow of vehicles along Groton Road. Operating conditions along Groton Road at Commerce Way were shown to be maintained at LOS "A" with negligible vehicle queueing predicted to occur as a result of the Project.

SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the intersection of Groton Road at Commerce Way in accordance with American Association of State Highway and Transportation Officials (AASHTO)[11] and MassDOT standards. Based on these measurements, it was determined that the available sight lines exceed the recommended minimum sight distance requirements for a 45 mph approach speed along Groton Road, consistent with the measured 85th percentile vehicle travel speed (41 mph) and 10 mph above the posted speed limit (35 mph).

RECOMMENDATIONS

A detailed transportation improvement program has been developed that is designed to provide safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Project Access

Access to the Project site will be provided by way of Commerce Way, the existing driveway that serves 540 Groton Road, which will be improved in conjunction with the Project (discussion follows). All trucks, excepting local deliveries of bituminous concrete product, will be directed to exit to the east and to use the Route 3/Groton Road (Route 40) interchange (Exit 33). This is consistent with the current restriction for exiting truck traffic at the Project site driveway (signs indicating "No Right Turn", "Left Turn Only" and "All Trucks Must Turn Left" are posted for vehicles exiting the driveway that will serve the Project). The following recommendations are offered with respect to the design and operation of Commerce Way:

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[11] *A Policy on Geometric Design of Highway and Streets,* 6th Edition; American Association of State Highway and Transportation Officials (AASHTO); Washington D.C.; 2011.

- Commerce Way will be reconstructed at its intersection with Groton Road to include the following enhancements:
  - Expansion of the island at the center of the driveway to separate and channelize (by way of a one-way slip lane) traffic entering the driveway from the east (westbound) from both exiting traffic and vehicles entering from the west (eastbound);
  - Providing a two-way drive on the west side of the expanded island to facilitate exiting traffic and vehicles entering from the west;
  - Installing new signs and pavement markings approaching Groton Road to delineate the expanded island; indicate the one-way entering direction of travel on the slip lane ("One-Way" and "Do Not Enter" signs to be installed); provide a marked centerline on the two-way portion of the driveway; and install a STOP-sign and marked STOP-line for traffic exiting the driveway to Groton Road; and
  - Repaving the Commerce Way approach and installing/upgrading the existing drainage system.
- The existing signs indicating "No Right Turn", "Left Turn Only" and "All Trucks Must Turn Left" should be retained to reinforce the turn restriction for exiting truck traffic.
- All signs and pavement markings to be installed on Commerce Way and within the Project site shall conform to the applicable standards of the *Manual on Uniform Traffic Control Devices* (MUTCD).[12]
- "Trucks Entering Ahead" warning signs should be installed on Groton Road approaching Commerce Way (both directions).
- Signs and landscaping to be installed along the Commerce Way, internal to the Project site and at the Groton Road/Commerce Way intersection should be designed and maintained so as not to restrict lines of sight.
- A maintenance plan will be established in consultation with the Town of Westford Department of Public Works that will entail a schedule for routine sweeping of Commerce Way and Groton Road approaching and departing Commerce Way.
- Trucks delivering bituminous concrete product manufactured at the Project site to destinations within the Town of Westford shall be given a color coded tag that is to be displayed in a prominent location within the cab of the truck and is readily observable from the outside of the vehicle.

Traffic Monitoring and Reporting Program

The Project proponent has agreed to limit the volume of traffic attributable to the Project to no more than 250 vehicle trips per day. In order to document compliance with this limitation and consistent with the prior recommendation of the Town's independent review consultant, a post-development traffic monitoring program will be implemented. The monitoring program will consist of the following elements:

[12] *Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, D.C.; 2009.

i) Provide a complete log of deliveries and materials imported to and exported from the Project to include all bituminous concrete sales, excepting material transferred within the Project site (i.e., trips that remain internal to the larger property that contains the Project);

ii) Provide daily employee time card verification showing number of employees working on a daily basis; and

iii) Maintaining a daily log of all other visitor trips (i.e., salesman, etc.).

It is the intention of the Project proponent to produce daily activity counts and to report these to the Town of Westford on a monthly basis.

With implementation of the above recommendations, safe and efficient access will be provided to the Project site and the Project can be accommodated within the confines of the existing and improved transportation system.

INTRODUCTION

Vanasse & Associates, Inc. (VAI) has conducted a Transportation Impact Assessment (TIA) in order to determine the potential impacts on the transportation infrastructure associated with the proposed construction of a bituminous concrete manufacturing facility to be located at 540 Groton Road (Route 40) in Westford, Massachusetts (hereafter referred to as the "Project"). This study evaluates the following specific areas as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; and identifies and analyzes existing traffic conditions and future traffic conditions, both with and without the Project, along Groton Road (Route 40) and at the intersections of Groton Road at Commerce Way (the driveway to 540 Groton Road) and Groton Road at Oak Hill Road.

The larger property which contains the Project site abuts Route 3, a principal arterial roadway and a State Highway under the jurisdiction of the Massachusetts Department of Transportation (MassDOT). The Project proponents have received a determination from MassDOT that a State Highway Access Permit will not be required for so called "indirect" access to Route 3 by way of Groton Road.

PROJECT DESCRIPTION

As proposed, the Project will entail the construction of a bituminous concrete manufacturing facility to be located at 540 Groton Road in Westford, Massachusetts. The facility is expected to produce an average of 1,500 tons of product per day and will be restricted to no more than 250 vehicle trips per diem[13] pursuant to the stipulations contained in the Remand Decision of the Land Court concerning the Project.[14] At least five (5) employees will oversee manufacturing operations. At present, the Project site consists of previously disturbed areas resulting from the on-going use of the property in its entirety for multiple industrial and commercial uses. Figure 1 depicts the Project site location in relation to the existing roadway network.

[13] A vehicle trip constitutes a two-way movement which, by definition and extension to the Project, limits the volume of traffic generated by the Project as measured at Groton Road to 125 vehicles entering and 125 vehicles exiting per day.

[14] Commonwealth of Massachusetts Land Court, Department of the Trial Court, 10 MISC 429867 (AHS); December 8, 2014.

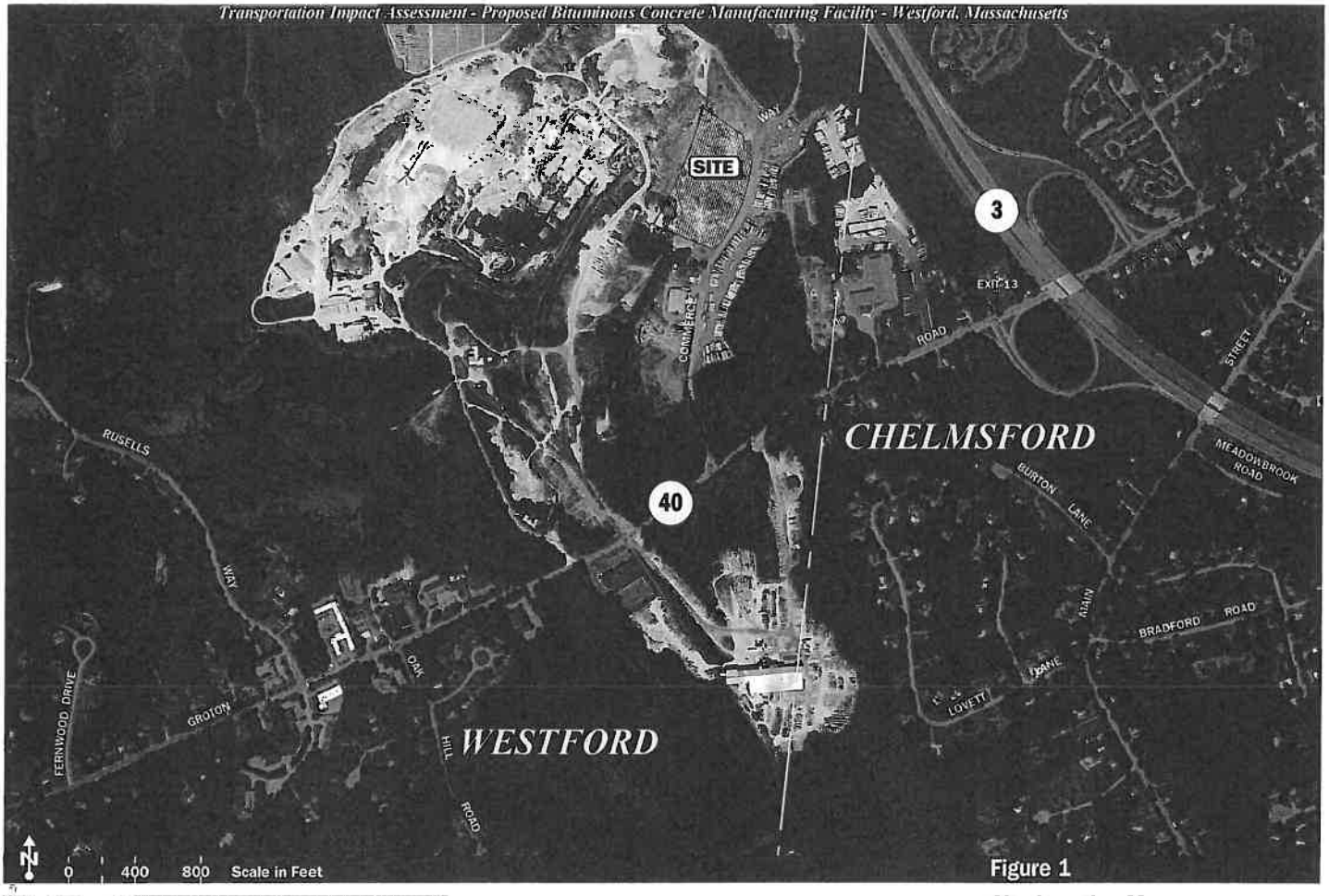

Figure 1

Site Location Map

Vanasse & Associates, Inc.
Transportation Engineers & Planners

Access to the Project site will be provided by way of Commerce Way, the existing driveway that serves 540 Groton Road, which will be improved in conjunction with the Project. All trucks, excepting local deliveries of bituminous concrete product, will be directed to exit to the east and to use the Route 3/Groton Road (Route 40) interchange (Exit 33). This is consistent with the current restriction for exiting truck traffic at the Project site driveway (signs indicating "No Right Turn", "Left Turn Only" and "All Trucks Must Turn Left" are posted for vehicles exiting the driveway that will serve the Project). Parking will be provided within the Project site for four (4) vehicles, including one (1) handicapped accessible space.

STUDY METHODOLOGY

This study was prepared in consultation with the Towns of Westford and Chelmsford, and the Massachusetts Department of Transportation (MassDOT); was performed in general accordance with MassDOT's *Transportation Impact Assessment (TIA) Guidelines,* the Town of Westford's *Guidelines for Preparation of a Transportation Impact Assessment* (as revised through January 18, 2006), the applicable sections of Section 9.3A, *Special Permit Performance Standards for Major Commercial Projects and Major Retail Projects*, of the Town of Westford Zoning By-Law, and the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports; and was conducted in three distinct stages.

The first stage involved an assessment of existing conditions in the study area and included an inventory of roadway geometrics; pedestrian and bicycle facilities; public transportation services; observations of traffic flow; and collection of daily and peak period traffic counts.

In the second stage of the study, future traffic conditions were projected and analyzed. Specific travel demand forecasts for the Project were assessed along with future traffic demands due to expected traffic growth independent of the Project. A seven-year time horizon was selected for analyses consistent with MassDOT's *Transportation Impact Assessment (TIA) Guidelines*. The traffic analysis conducted in stage two identifies existing or projected future roadway capacity, traffic safety, and site access issues.

The third stage of the study presents and evaluates measures to address traffic and safety issues, if any, identified in stage two of the study.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in January and February 2015. The field investigation consisted of an inventory of existing roadway geometrics; pedestrian and bicycle facilities; public transportation services; traffic volumes; and operating characteristics; as well as posted speed limits and land use information within the study area. The study area for the Project is depicted on Figure 2 along with roadway jurisdiction, and was selected to contain the major roadway providing access to the Project site, Groton Road (Route 40), as well as the intersections of Groton Road at Commerce Way (the driveway to 540 Groton Road) and Groton Road at Oak Hill Road. This study area is consistent with that which was previously evaluated for the Project and is reflective of the relatively low volume of traffic that is expected to be generated by the facility (not to exceed 250 vehicle trips per day).

The following describes the study area roadways and intersections.

Roadway

Groton Road (Route 40)

Groton Road (Route 40) is a two-lane, urban principal arterial roadway west of Route 3 and an urban minor arterial roadway to the east, that traverses the study area in a general northeast-southwest direction providing a full access interchange with Route 3 to the east of the Project site (Exit 33). Groton Road is under local jurisdiction with the exception of the segment between Ward Way and Scotty Hollow Drive (within the Route 3/Groton Road interchange area) where it is under MassDOT jurisdiction. Within the study area, Groton Road provides two 12-foot wide travel lanes separated by a double-yellow centerline with additional turning lanes provided at major intersections. Pedestrian and bicycle facilities are not provided along Groton Road within the study area. The posted speed limit along Groton Road within the study area is 35 miles per hour (mph). Land use along Groton Road within the study area consists of the Project site; other industrial, commercial and manufacturing properties; and areas of open and wooded space.

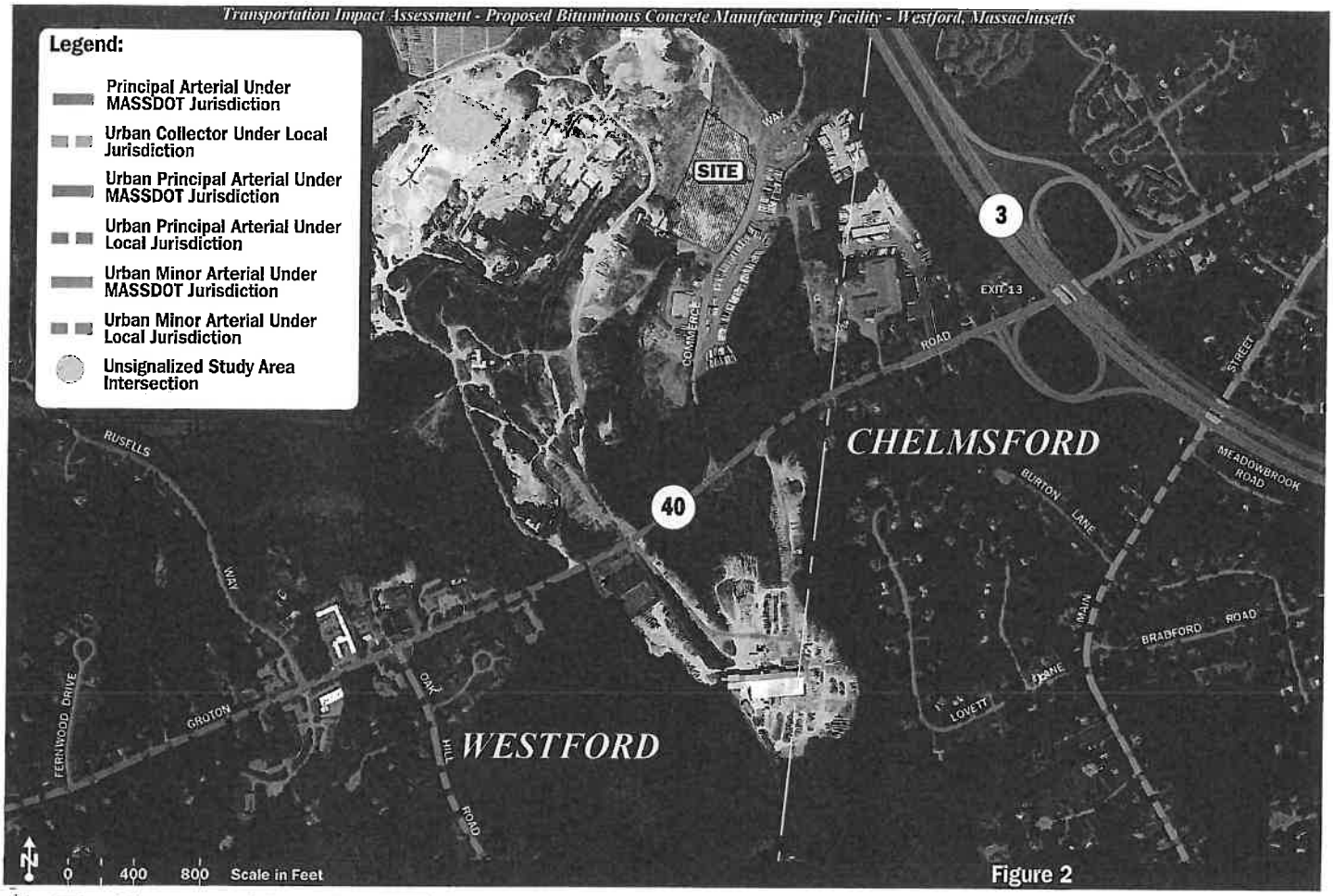

Figure 2

Study Area, Roadway Jursidiction and Sensitive Receptors Map

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Intersections

Table 1 and Figure 3 summarize lane use, traffic control, and pedestrian and bicycle accommodations at the study area intersections as observed in January 2015.

Table 1
STUDY AREA INTERSECTION DESCRIPTION

Intersection	Traffic Control Type[a]	No. of Travel Lanes Provided	Shoulder Provided? (Yes/No/Width)	Pedestrian Accommodations? (Yes/No/Description)	Bicycle Accommodations? (Yes/No/Description)
Groton Road/ Commerce Way (540 Groton Road)	S	1 per direction	Yes – 1 to 2 feet on Groton Road	No	No
Groton Road/ Oak Hill Road	S	1 per direction with left-turn lanes provided on Groton Road approaches and a right-turn lane on Oak Hill Road south leg	Yes – 1 to 2 feet on all approaches	Yes – Crosswalk with pedestrian crossing warning signs on Groton Road west leg; sidewalk along west side of Oak Hill Road south of intersection	No

[a]TS = traffic signal control; S = STOP-sign control; AS = All-Way Stop-sign control; Y = Yield-sign control; NC = no control present.

EXISTING TRAFFIC VOLUMES

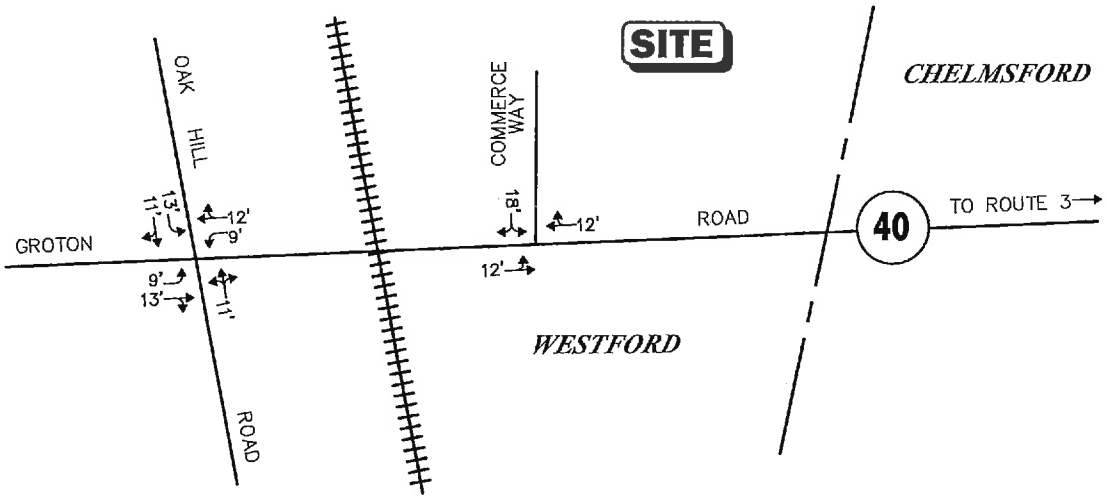
In order to determine existing traffic-volume demands and flow patterns within the study area, automatic traffic recorder (ATR) counts, manual turning movement counts (TMCs) and vehicle classification counts were completed in January and February 2015 while public schools were in regular session. The ATR counts were conducted on Groton Road in the vicinity of the Commerce Way in order to record weekday daily traffic conditions over an extended period, with weekday morning (7:00 to 9:00 AM), weekday evening (4:00 to 6:00 PM) and Saturday midday (11:00 AM to 2:00 PM) peak period manual TMCs performed at the study intersections. These time periods were selected for analysis purposes as they are representative of the peak traffic volume hours for both the Project and the adjacent roadway network.

Traffic Volume Adjustments

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, MassDOT weekday seasonal factors for Group 6 roadways (urban arterials, collectors and rural arterials, the MassDOT functional classification for Groton Road/Route 40) were reviewed.[15] Based on a review of this data, it was determined that traffic volumes for the months of January and February are approximately 3.0 percent and 1.0 percent below average-month conditions, respectively, and, therefore, were adjusted upward accordingly in order to represent traffic volumes under average-month conditions in accordance with MassDOT standards.

Recognizing that activities associated with the existing materials processing operation within the larger property that contains the Project site were limited during the traffic count period

[15]MassDOT Traffic Volumes for the Commonwealth of Massachusetts; 2011 Weekday Seasonal Factors, Group 6 – Urban Arterials, Collectors and Rural Arterials.



Not To Scale

Figure 3

Existing Intersection Lane Use and Travel Lane Width

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(January), the turning movement data for vehicles entering and exiting Commerce Way was adjusted upward by 50 percent in order to represent traffic volumes under peak construction season conditions (June through September).

The 2015 Existing traffic volumes are summarized in Table 2, with the weekday morning, weekday evening and Saturday midday peak-hour traffic volumes graphically depicted on Figure 4. Note that the peak-hour traffic volumes reflected in Table 2 were obtained from the TMCs and are reflected on the aforementioned figures.

Table 2
2015 EXISTING TRAFFIC VOLUMES

Location	AWT[a]	Saturday[b]	VPH[c]	K Factor[d]	Directional Distribution
Groton Road east of Commerce Way:	13,705	11,355	--	--	--
Weekday Morning Peak Hour (8:00 – 9:00 AM)	--	--	1,099	8.0	68.7% EB
Weekday Evening Peak Hour (5:00 – 6:00 PM)	--	--	1,174	8.6	55.2% WB
Saturday Midday Peak Hour (12:00 – 1:00 PM)	--	--	946	8.3	59.2% EB

[a]Average weekday traffic in vehicles per day.
[b]Average Saturday traffic in vehicles.
[c]Vehicles per hour.
[d]Percent of daily traffic occurring during the peak-hour.
EB = eastbound; WB = westbound.

As can be seen in Table 2, Groton Road in the vicinity of Commerce Way was found to accommodate approximately 13,705 vehicles on an average weekday (two-way, 24-hour volume), with approximately 1,099 vehicles per hour (vph) during the weekday morning peak-hour and 1,174 vph during the weekday evening peak-hour. On a Saturday, this section of Groton Road was found to accommodate approximately 11,355 vehicles (again, two-way, 24-hour volume), with 946 vph during the Saturday midday peak-hour.

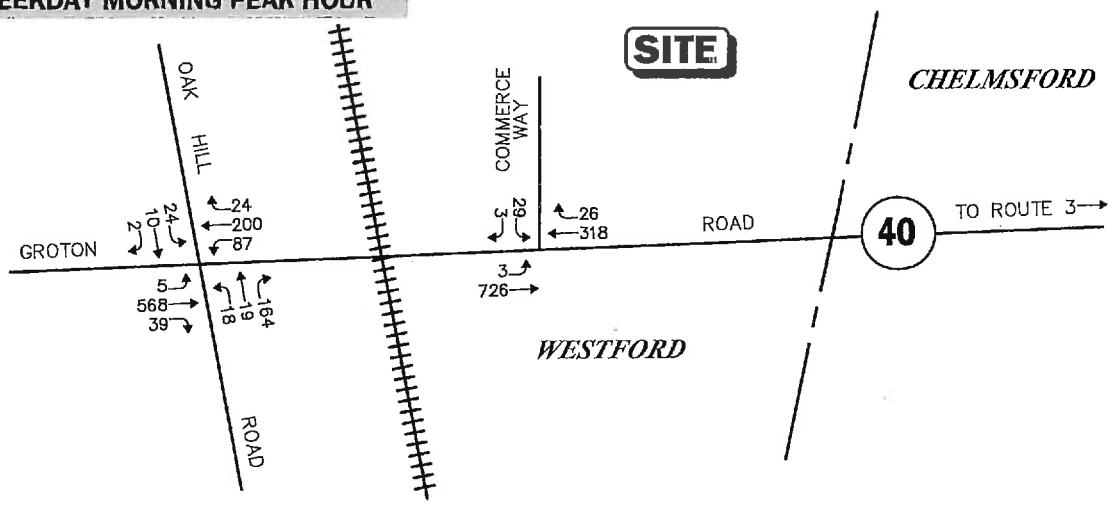
PEDESTRIAN AND BICYCLE FACILITIES

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in January 2015. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. Sidewalks are not currently provided along Groton Road within the study area. A marked crosswalk is provided for crossing the Groton Road west leg of the Groton Road/Oak Hill Road intersection that includes accompanying pedestrian crossing warning signs, and a sidewalk is provided along the west side of Oak Hill Road south of Groton Road.

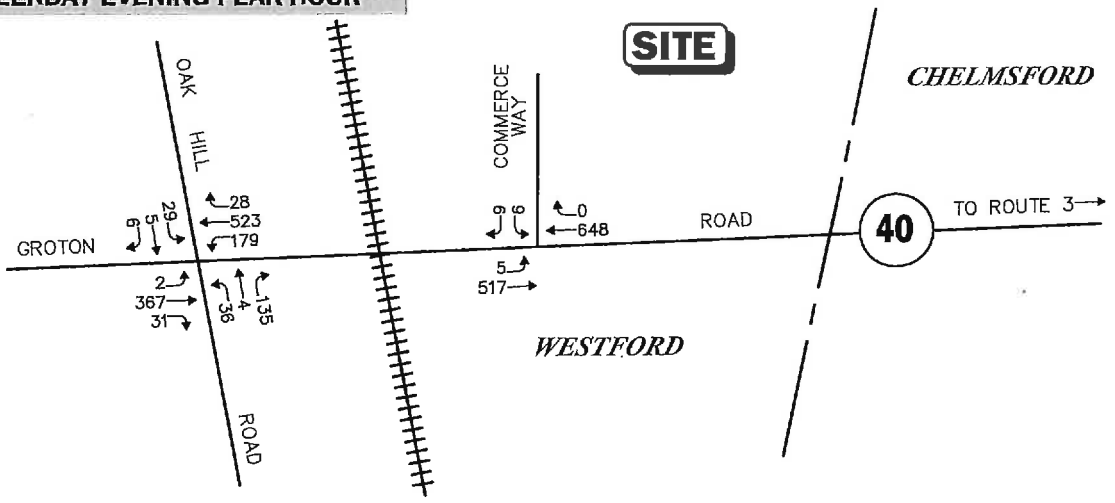
Formal bicycle facilities were not identified within the study area; however, portions of Groton Road appear to provide sufficient width (combined travel lane and shoulder) to support bicycle travel in a shared travelled-way configuration.[16]

[16]A minimum combined travel lane and paved shoulder width of 14-feet is required to support bicycle travel in a shared travelled-way condition.

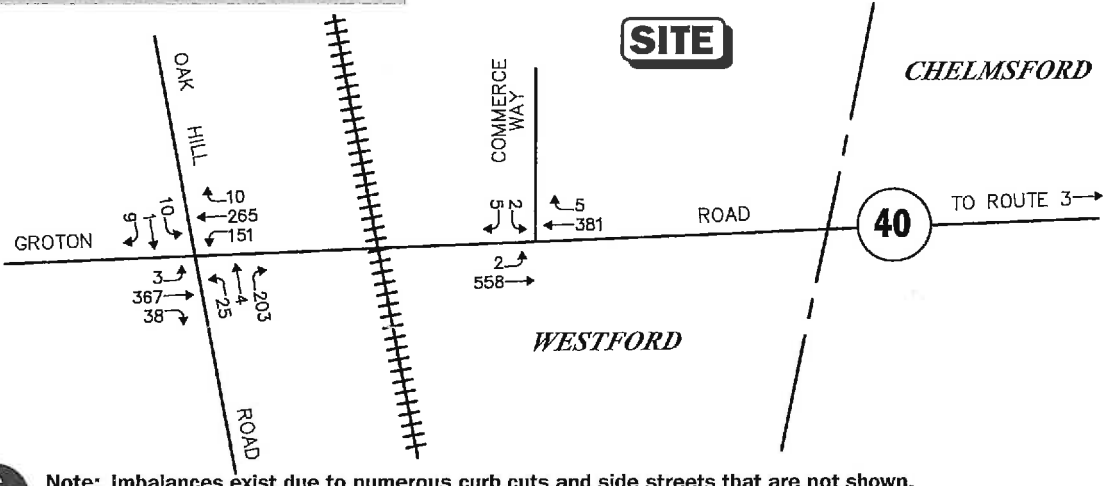
WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



SATURDAY MIDDAY PEAK HOUR



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 4

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2015 Existing Peak Hour Traffic Volumes

PUBLIC TRANSPORTATION

Public transportation services are currently not available within the immediate study area; however, the Lowell Regional Transit Authority (LRTA) does provide fixed-route bus service to the Town of Westford. LRTA Bus Route 15, *Chelmsford/Westford via Routes 129/110*, provides bus service along Route 110 to the south of the Project site and the study area. In addition, LRTA Bus Route 17, *North Chelmsford via Middlesex*, provides bus service along Groton Road within the Town of Chelmsford, with the closest stop to the Project site located at the Triangle Store (intersection of Groton Road at Main Street), northeast of the Route 3/Groton Road interchange.

The public transportation schedules and fare information is provided in the Appendix.

SPOT SPEED MEASUREMENTS

Vehicle travel speed measurements were performed on Groton Road in the vicinity of Commerce Way over a 72-hour period (Thursday through Saturday) in conjunction with the ATR counts. Table 3 summarizes the vehicle travel speed measurements.

Table 3
VEHICLE TRAVEL SPEED MEASUREMENTS

	Groton Road	
	Eastbound	Westbound
Mean Travel Speed (mph)	37	38
85th Percentile Speed (mph)	41	42
Posted Speed Limit (mph)	35	35

mph = miles per hour.

As can be seen in Table 3, the mean (average) vehicle travel speed along Groton Road in the vicinity of Commerce Way was found to be approximately 37 mph. The average measured 85th percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be approximately 42 mph, which is 7 mph above the posted speed limit (35 mph). The 85th percentile speed is used as the basis of engineering design and in the evaluation of sight distances, and is often used in establishing posted speed limits.

MOTOR VEHICLE CRASH DATA

Motor vehicle crash information for the study area intersections was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent five-year period available (2008 through 2012, inclusive) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized by intersection, type, severity, and day of occurrence, and presented in Table 4.

As can be seen in Table 4, the study area intersections were found to have experienced an average of five (5) or fewer reported motor vehicle crashes per year over the five-year review period, the majority of which involved property damage only, occurred on a weekday and were reported as angle-type collisions. The Groton Road/Commerce Way intersection was found to have a motor vehicle crash rate below both the MassDOT statewide and District averages for an unsignalized intersection for the MassDOT Highway Division District in which the intersection is located (District 3).

The Groton Road/Oak Hill Road intersection was found to have a motor vehicle crash rate above both the MassDOT statewide and District 3 averages for an unsignalized intersection, with one (1) fatal motor vehicle crash reported to have occurred at the intersection within the five-year review period. The fatal motor vehicle crash was reported as an angle-type collision and occurred on Sunday, September 16, 2012 at approximately 3:00 PM under clear weather conditions. The Groton Road/Oak Hill Road intersection was also ranked 98th on the top 100 high crash intersections for 2006-2008 in the Northern Middlesex Region.[17] Improvements are planned at the intersection by others (discussion follows) that include geometric modifications and the installation of a traffic control signal, measures which will help to reduce the frequency of occurrence of angle-type collisions at the intersection (the predominant crash type reported). The detailed MassDOT Crash Rate Worksheets are provided in the Appendix.

[17] Ibid 6.

Table 4
MOTOR VEHICLE CRASH DATA SUMMARY[a]

	Groton Road/ Commerce Way (540 Groton Road)	Groton Road/ Oak Hill Road
Traffic Control Type:[b]	U	U
Year:		
2008	0	9
2009	1	3
2010	0	4
2011	0	3
2012	2	6
Total	3	25
Average	0.60	5.00
Rate[c]	0.12	0.92
MassDOT Crash Rate:[d]	0.60/0.66	0.60/0.66
Significant?[e]	No	Yes
Type:		
Angle	1	17
Rear-End	1	5
Head-On	0	1
Sideswipe	0	2
Fixed Object	0	0
Pedestrian/Bicycle	0	0
Unknown/Other	1	0
Total	3	25
Day of Week:		
Monday through Friday	3	19
Saturday	0	3
Sunday	0	3
Total	3	25
Severity:		
Property Damage Only	3	18
Personal Injury	0	6
Fatality	0	1
Total	3	25

[a]Source: MassDOT Safety Management/Traffic Operations Unit records, 2008 through 2012.
[b]Traffic Control Type: U = unsignalized.
[c]Crash rate per million vehicles entering the intersection.
[d]Statewide/District crash rate.
[e]The intersection crash rate is significant if it is found to exceed the MassDOT crash rate for the MassDOT Highway Division District in which the intersections are located (District 3).

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2022, which reflects a seven-year planning horizon consistent with MassDOT's *Transportation Impact Assessment (TIA) Guidelines*. Independent of the Project, traffic volumes on the roadway network in the year 2022 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated Project-generated traffic volumes superimposed upon the 2022 No-Build traffic volumes reflect 2022 Build traffic volume conditions with the Project.

FUTURE TRAFFIC GROWTH

Future traffic growth is a function of the expected land development in the immediate area and the surrounding region. Several methods can be used to estimate this growth. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all traffic volumes under study. The drawback to such a procedure is that some turning volumes may actually grow at either a higher or a lower rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This procedure produces a more realistic estimate of growth for local traffic; however, potential population growth and development external to the study area would not be accounted for in the resulting traffic projections.

To provide a conservative analysis framework, both procedures were used, the salient components of which are described below.

Specific Development by Others

The Planning Departments of the Towns of Westford and Chelmsford were contacted in order to determine if there were any projects planned within the study area that would have an impact on future traffic volumes at the study intersections. Based on these discussions, the following project was identified for inclusion in this assessment:

- ***Spaulding Hill Estates, Westford, Massachusetts.*** This project will entail the construction of a 32-lot residential subdivision to be located along the north side of Groton Road, between Dunstable Road and St. Augustine Drive (west of the Project site), in Westford,

Massachusetts. Traffic volumes associated with this development were estimated using trip-generation statistics published by the Institute of Transportation Engineers (ITE)[18] for the appropriate land use and were assigned onto the study area roadway network based on existing traffic patterns.

No other developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the general background traffic growth rate.

General Background Traffic Growth

Traffic-volume data compiled by MassDOT and the Northern Middlesex Council of Governments (NMCOG) from permanent count stations and historic traffic counts in the area were reviewed in order to determine general background traffic growth trends. Based on a review of this data, it was determined that traffic volumes along Groton Road as measured in Chelmsford at the Westford Town Line between 2003 and 2012 have generally increased by approximately 1.45 percent per year.[19] In order to provide a conservative (high) analysis scenario and a prudent planning condition for the Project, a slightly higher than average 1.5 percent per year compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Roadway Improvement Projects

MassDOT and the Towns of Westford and Chelmsford were contacted in order to determine if there were any planned roadway improvement projects expected to be completed within the study area. Based on these discussions, the following roadway improvement project was identified for review in conjunction with this assessment:

- ***Groton Road/Oak Hill Road Intersection Improvement Project, Westford, Massachusetts.*** This intersection improvement project will entail the reconstruction of the intersection of Groton Road at Oak Hill Road to include geometric modifications, drainage improvements, pedestrian and bicycle accommodations, and the installation of a traffic control signal in order to improve both traffic operations and safety. These improvements are currently at the conceptual design level and are listed in the Northern Middlesex Metropolitan Planning Organization FFY 2015-2018 Transportation Improvement Program (TIP) list for funding in 2017, within the horizon year of this assessment (2022).

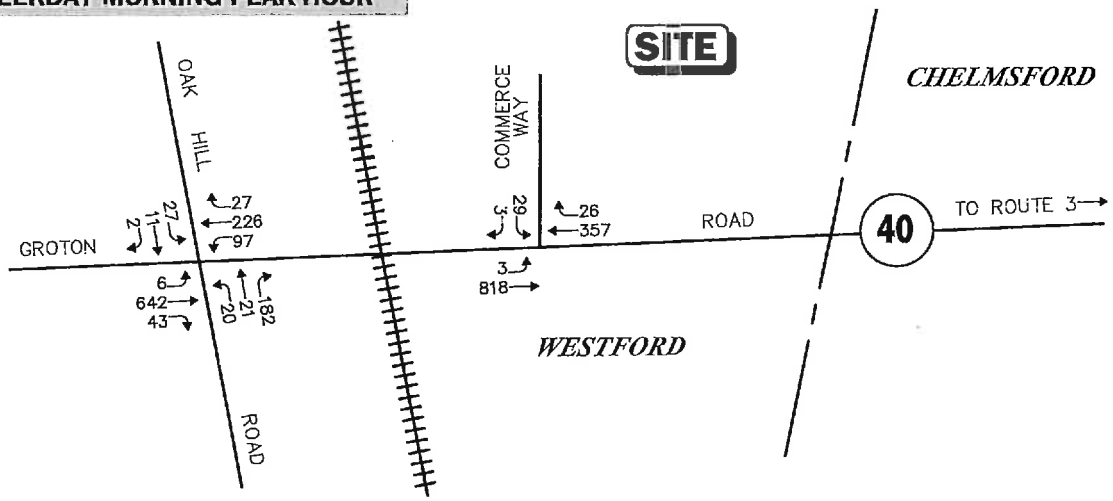
No other roadway improvement projects outside of routine maintenance activities were identified to be planned within the study area at this time.

No-Build Traffic Volumes

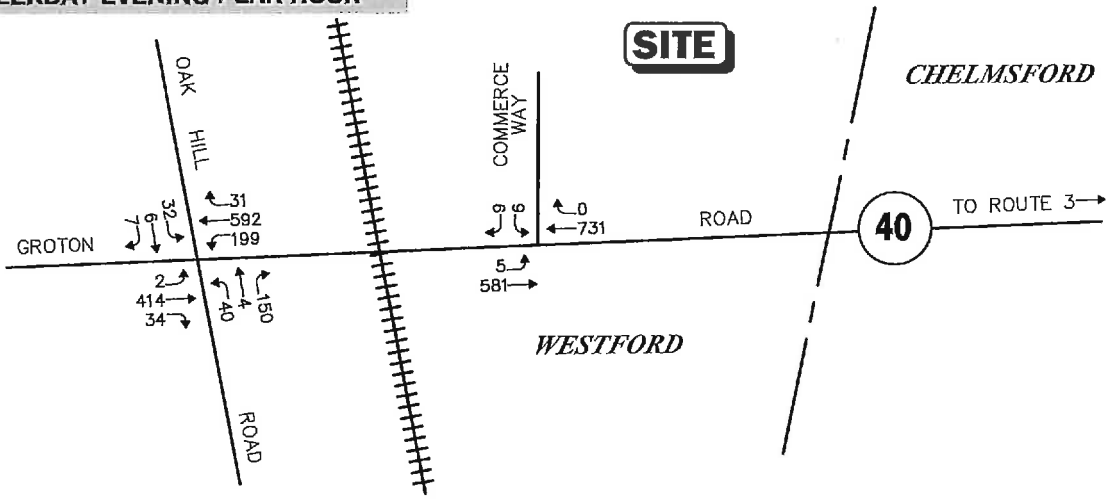
The 2022 No-Build condition peak-hour traffic-volumes were developed by applying the 1.5 percent per year compounded annual background traffic growth rate to the 2015 Existing peak-hour traffic volumes and then superimposing the peak-hour traffic volumes associated with the identified specific development project by others. The resulting 2022 No-Build weekday morning, weekday evening and Saturday midday peak-hour traffic volumes are shown on Figure 5.

[18] Ibid 7.
[19] Ibid 8.

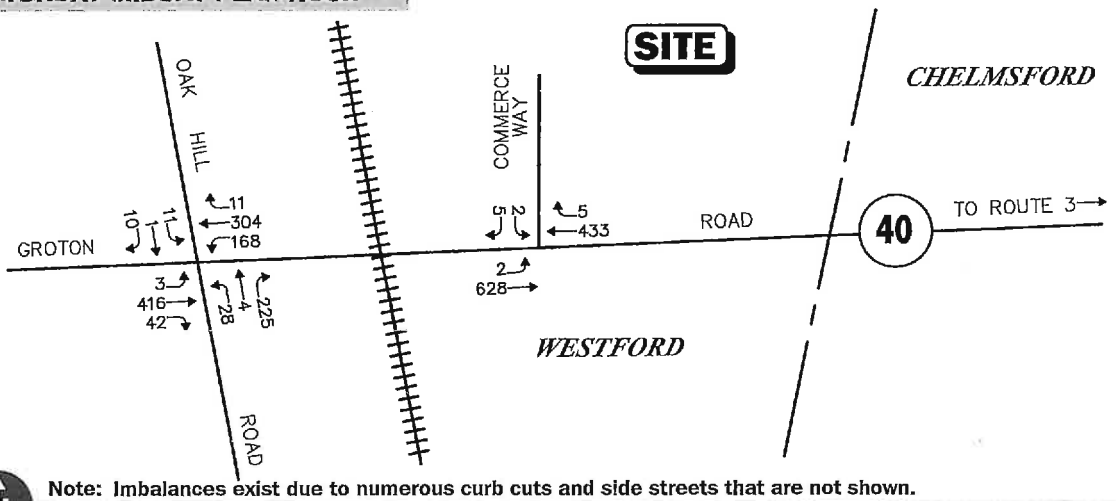
WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



SATURDAY MIDDAY PEAK HOUR



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 5

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2022 No-Build
Peak Hour Traffic Volumes

PROJECT-GENERATED TRAFFIC

Design year (2022 Build) traffic volumes for the study area roadways were determined by estimating Project-generated traffic volumes and assigning those volumes on the study roadways. The following sections describe the methodology used to develop the anticipated traffic characteristics of the Project.

As proposed, the Project will entail construction of a bituminous concrete manufacturing facility which is projected to manufacture an average of 1,500 tons of product per day, and will be restricted to no more than 250 vehicle trips per day as stipulated in the Remand Decision of the Land Court concerning the Project.[20] At least five (5) employees will oversee manufacturing operations.

The manufacture of bituminous concrete product requires two (2) primary components: 1) liquid asphalt (binder); and 2) aggregate (graded stone, sand and Recycled Asphalt Pavement (RAP)). The aggregate component of the mix will consist of both new and recycled materials, with the latter commonly derived from RAP obtained from milling or similar pavement reclaimation activities. It is anticipated that a portion of the non-RAP aggregate required for the Project will be derived from the Fletcher Quarry, the delivery of which will be made by way of trucks traversing roadways internal to the larger property that contains the Project and will not result in additional traffic along Groton Road as a result of the Project.

Based on the information contained in the Remand Order specific to the Project,[21] the following daily trip projections can be derived for the Project with respect to the import of materials to the Project site required in order to produce an average of 1,500 tons of product per day:

- *Liquid asphalt:* 2 trucks per day (4 vehicle trips)
- *RAP:* 13 trucks per day (26 vehicle trips)
- *Imported Aggregate:* 24 trucks per day (48 vehicle trips)
- *Exported Product:* 64 trucks per day (128 vehicle trips)
- *#2 Fuel Oil:* 1 truck per day (2 vehicle trips)
- *Employees (5 employees):* 8 trips per day (16 vehicle trips)

TOTAL: 112 trips (224 vehicle trips)

It is apparent that the calculated traffic volume projections for the facility (224 vehicle trips per day) are below the 250 daily vehicle trip limitation stipulated for the Project. In order to adjust the calculations to reflect a 250 daily vehicle trip projection while holding the average of 1,500 tons per day materials production, the amount of imported aggregate was increased to 37 truck trips (vs. 24 truck trips) and 74 vehicle trips (vs. 48 vehicle trips).

Peak-hour traffic volume projections for the Project were derived from the daily trip estimates and operational information provided by the Project proponent. In general, approximately 15 percent of the daily truck traffic is expected to occur during the weekday morning peak-hour, with 10 percent expected to occur during the weekday evening and Saturday midday peak hours.

Table 5 summarizes the anticipated traffic characteristics of the Project using the above methodology.

---

[20] Ibid 1.

[21] Ibid 1.

Table 5
TRIP GENERATION SUMMARY

Time Period/Direction	Trucks (A) Bituminous Concrete Manufacturing[a]	Trucks (B) Imported Materials[b]	Trucks (C = A + B) Total	Automobiles (D) Employees	Total Vehicles (E = C + D) Total
Average Weekday Daily:					
Entering	67	50	117	8	125
Exiting	67	50	117	8	125
Total	134	100	234	16	250
Weekday Morning Peak Hour:					
Entering	9	8	17	2	19
Exiting	11	7	18	0	18
Total	20	15	35	2	37
Weekday Evening Peak Hour:					
Entering	7	5	12	0	12
Exiting	6	5	11	2	13
Total	13	10	23	2	25
Saturday:					
Entering	67	50	117	8	125
Exiting	67	50	117	8	125
Total	134	100	234	16	250
Saturday Midday Peak Hour:					
Entering	7	5	12	0	12
Exiting	7	5	12	0	12
Total	14	10	24	0	24

[a]Includes 64 trucks (128 vehicle trips) per day for exported product, 2 trucks (4 vehicle trips) per day for liquid asphalt and 1 truck (2 vehicle trips) per day for diesel fuel.
[b]Includes 37 trucks (74 vehicle trips) per day for imported aggregate and 13 trucks (26 vehicle trips) per day for RAP.

Project-Generated Traffic Volume Summary

As can be seen in Table 5, using the aforementioned methodology and incorporating the 250 vehicle trip per day stipulated limitation for the Project, the Project is predicted to generate approximately 250 vehicle trips on an average weekday and Saturday (two-way volume over the operational day of the Project, or 125 vehicles entering and 125 exiting), with 37 vehicle trips (19 vehicles entering and 18 exiting) expected during the weekday morning peak-hour, 25 vehicle trips (12 vehicles entering and 13 exiting) during the weekday evening peak-hour and 24 vehicle trips (12 vehicles entering and 12 exiting) during the Saturday midday peak-hour.

Trip Distribution and Assignment

Excepting employee trips and local deliveries of bituminous concrete product (anticipated to be less than 5 percent of the traffic generated by the Project), Project-related truck traffic will be directed to exit to the east on Groton Road and will use the Route 3/Groton Road (Route 40) interchange. This is consistent with the current restriction for exiting truck traffic at the Project site driveway (signs indicating "No Right Turn", "Left Turn Only" and "All Trucks Must Turn Left" are posted for vehicles exiting the driveway that will serve the Project). For the purpose of this assessment and to evaluate potential impacts of local deliveries at the Groton Road/Oak Hill Road intersection, it was assumed that 5 percent of Project-related traffic would travel to/from the west on Groton Road. The general trip distribution for the Project is graphically depicted on Figure 6 and summarized in Table 6. The additional traffic expected to be generated by the Project was assigned on the study area roadway network as shown on Figure 7.

Table 6
TRIP-DISTRIBUTION SUMMARY

Roadway	Directions (To/From)	Percent
Groton Road (Route 40)	East	95
Groton Road (Route 40)	West	5
TOTAL		100

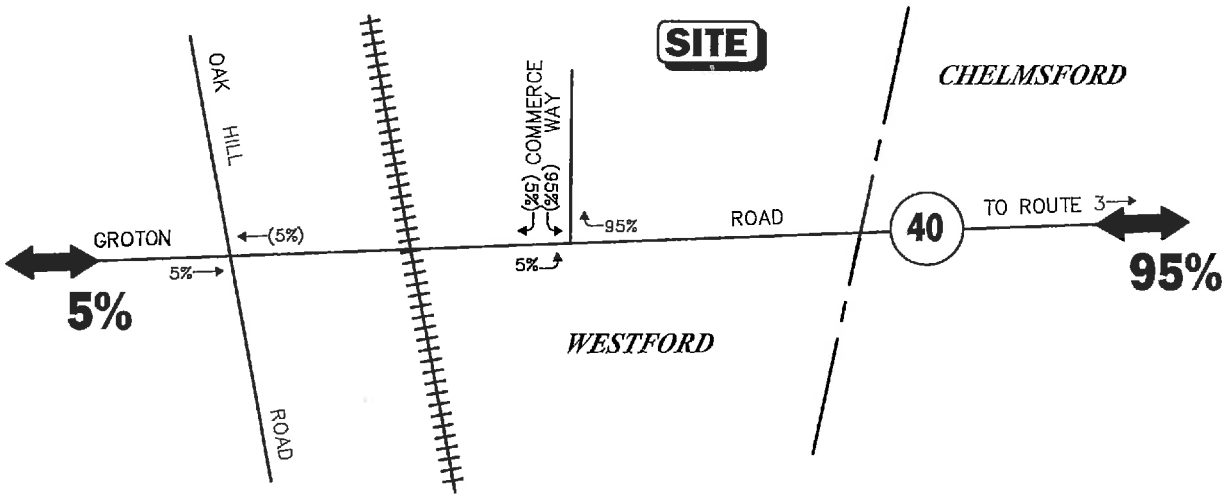
FUTURE TRAFFIC VOLUMES - BUILD CONDITION

The 2022 Build condition traffic volumes consist of the 2022 No-Build traffic volumes with the additional traffic expected to be generated by the Project added to them. The 2022 Build weekday morning, weekday evening and Saturday midday peak-hour traffic-volumes are graphically depicted on Figure 8.

A summary of peak-hour projected traffic-volume increases external to the study area that is the subject of this assessment is shown in Table 7. These volumes are based on the expected increases from the Project.

Legend:

XX	Entering Trips
(XX)	Exiting Trips



Not To Scale

Figure 6

Trip Distribution Map

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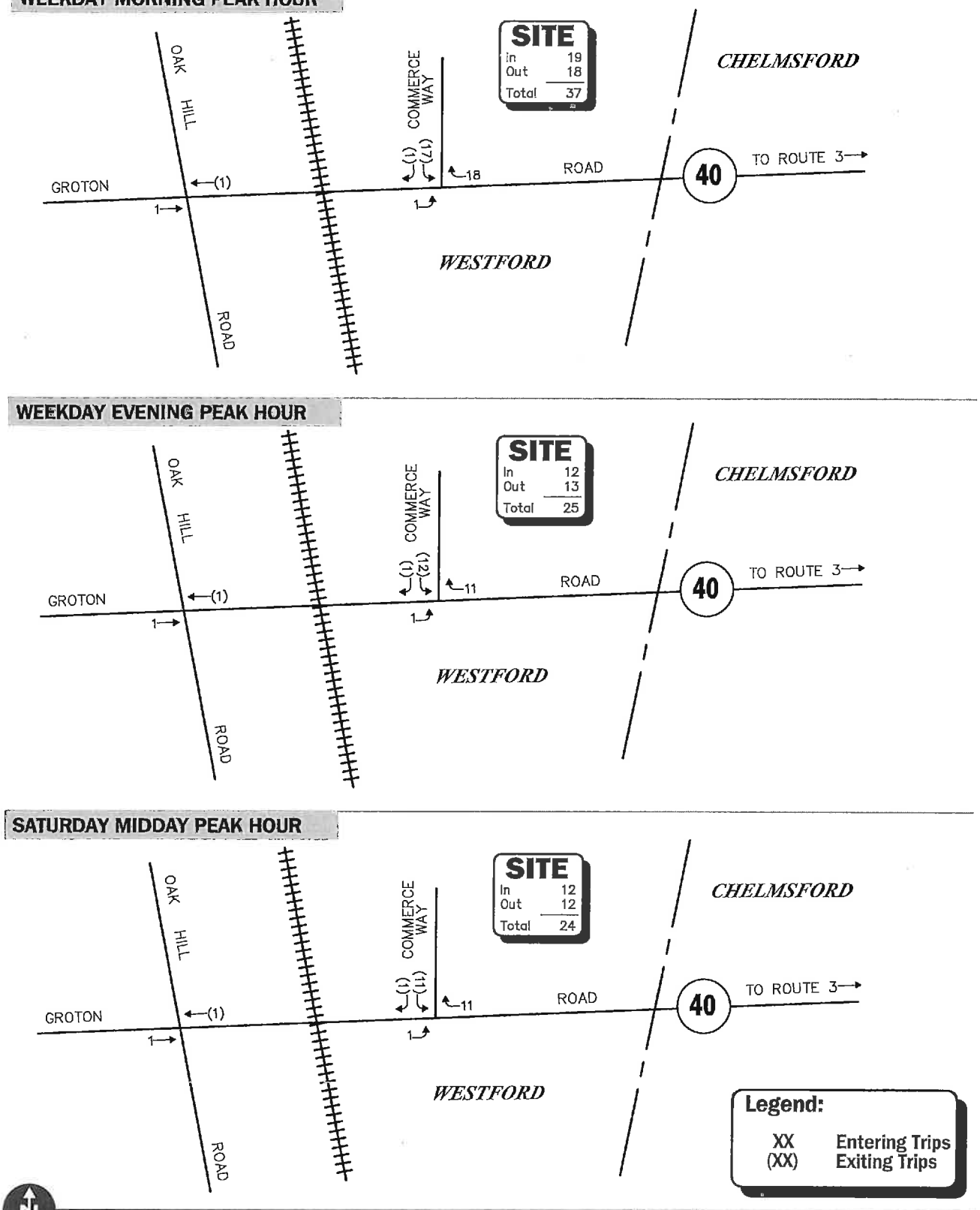

Figure 7

Project Generated Peak Hour Traffic Volumes

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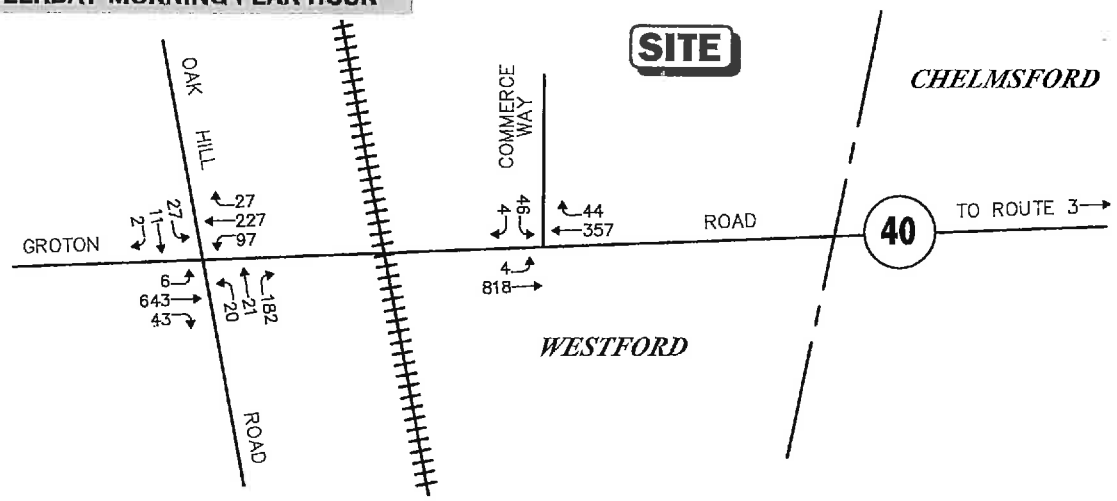
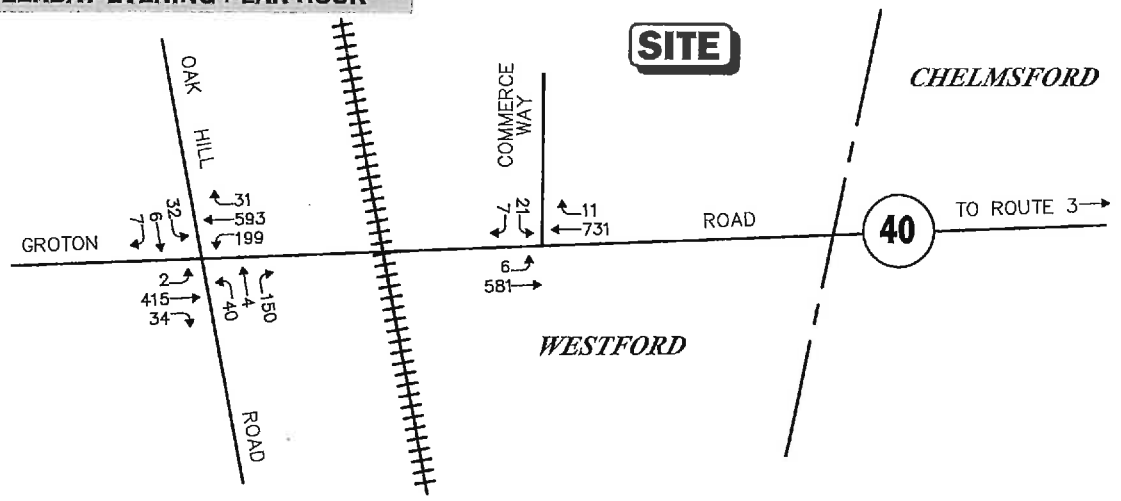
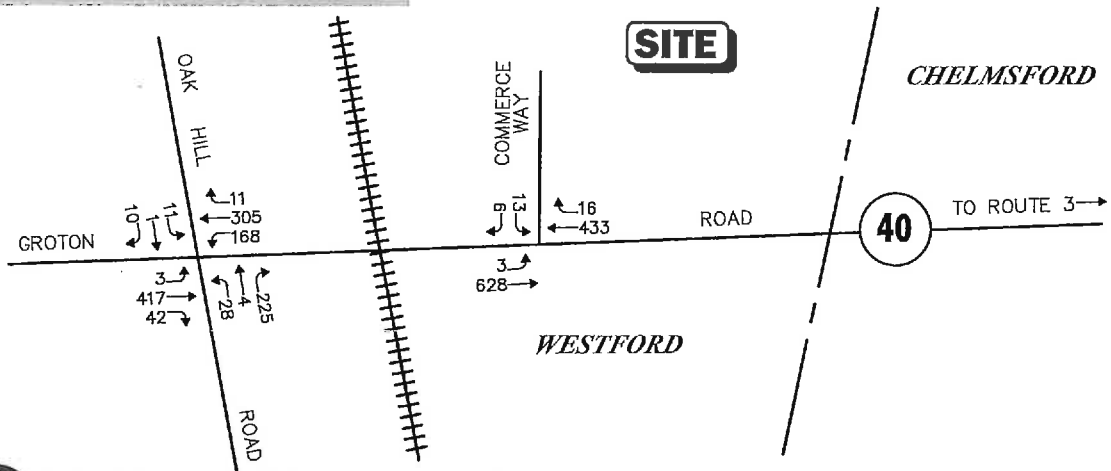
WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



SATURDAY MIDDAY PEAK HOUR



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 8

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2022 Build
Peak Hour Traffic Volumes

Table 7
PEAK-HOUR TRAFFIC-VOLUME INCREASES

Location/Peak Hour	2015 Existing	2022 No-Build	2022 Build	Traffic Volume Increase Over No-Build	Percent Increase Over No-Build
Groton Road, east of Commerce Way:					
Weekday Morning	1,099	1,230	1,265	35	2.8
Weekday Evening	1,174	1,321	1,344	23	1.7
Saturday Midday	946	1,068	1,090	22	2.1
Groton Road, west of Oak Hill Road:					
Weekday Morning	832	939	941	2	0.2
Weekday Evening	965	1,089	1,091	2	0.2
Saturday Midday	707	803	805	2	0.2

As shown in Table 7, Project-related traffic-volume increases external to the study area relative to 2022 No-Build conditions are anticipated to range from 0.2 to 2.8 percent during the peak periods, with vehicle increases shown to range from 2 to 35 vehicles, with the largest increases occurring on the segment of Groton Road between the Route 3/Groton Road interchange and Commerce Way. ***Such increases are considered nominal when dispersed over the peak-hour and would not result in a material impact (increase) on motorist delays or vehicle queuing.***

TRAFFIC OPERATIONS ANALYSIS

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing, No-Build and Build traffic volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

METHODOLOGY

Levels of Service

A primary result of capacity analyses is the assignment of level of service to traffic facilities under various traffic-flow conditions.[22] The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing congested or constrained operating conditions.

Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

[22]The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2010.

Unsignalized Intersections

The six levels of service for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.
- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach lane, with extreme control delays resulting.

The levels of service of unsignalized intersections are determined by application of a procedure described in the 2010 *Highway Capacity Manual.*[23] Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the affects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the 2010 *Highway Capacity Manual.* Table 8 summarizes the relationship between level of service and average control delay for two way stop controlled and all-way stop controlled intersections.

Table 8
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]

Level-Of-Service by Volume-to-Capacity Ratio		Average Control Delay
v/c ≤ 1.0	v/c > 1.0	(Seconds Per Vehicle)
A	F	≤10.0
B	F	10.1 to 15.0
C	F	15.1 to 25.0
D	F	25.1 to 35.0
E	F	35.1 to 50.0
F	F	>50.0

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010; page 19-2.

[23]*Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010.

Signalized Intersections

The six levels of service for signalized intersections may be described as follows:

- *LOS A* describes operations with very low control delay; most vehicles do not stop at all.
- *LOS B* describes operations with relatively low control delay. However, more vehicles stop than LOS A.
- *LOS C* describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- *LOS D* describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable.
- *LOS E* describes operations with high control delay values. Individual cycle failures are frequent occurrences.
- *LOS F* describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Levels of service for signalized intersections were calculated using the Percentile Delay Method implemented as a part of the Synchro™ 8 software as suggested by MassDOT in order to compensate for errors found when employing the 2010 *Highway Capacity Manual* methodology as a part of the software. The Percentile Delay Method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on "percentile" delay. Level-of-service designations are based on the criterion of percentile delay per vehicle and is a measure of: i) driver discomfort; ii) motorist frustration; and iii) fuel consumption; and includes a uniform delay based on percentile volumes using a Poisson arrival pattern, an initial queue move-up time, and a queue interaction delay that accounts for delays resulting from queues extending from adjacent intersections. Table 9 summarizes the relationship between level-of-service and percentile delay, and uses the same numerical delay thresholds as the HCM method. The tabulated percentile delay criterion may be applied in assigning level-of-service designations to individual lane groups, to individual intersection approaches, or to entire intersections.

Table 9
LEVEL-OF-SERVICE CRITERIA
FOR SIGNALIZED INTERSECTIONS

Level of Service	Percentile Delay Per Vehicle (Seconds)
A	≤10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	>80.0

Vehicle Queue Analysis

Vehicle queue analyses are a direct measurement of an intersection's ability to process vehicles under various traffic control and volume scenarios and lane use arrangements. The vehicle queue analysis was performed using the Synchro™ intersection capacity analysis software which is based upon the methodology and procedures presented in the 2010 *Highway Capacity Manual.* The Synchro™ vehicle queue analysis methodology is a simulation based model which reports the number of vehicles that experience a delay of six seconds or more at an intersection. For signalized intersections, Synchro™ reports both the average (50th percentile) the 95th percentile vehicle queue. For unsignalized intersections, Synchro™ reports the 95th percentile vehicle queue. Vehicle queue lengths are a function of the capacity of the movement under study and the volume of traffic being processed by the intersection during the analysis period. The 95th percentile vehicle queue is the vehicle queue length that will be exceeded only 5 percent of the time, or approximately three minutes out of sixty minutes during the peak one hour of the day (during the remaining fifty-seven minutes, the vehicle queue length will be less than the 95th percentile queue length).

ANALYSIS RESULTS

Level-of-service and vehicle queue analyses were conducted for 2015 Existing, 2022 No-Build and 2022 Build conditions for the intersections within the study area. The results of the intersection capacity and vehicle queue analyses are summarized in Tables 10 and 11.

The following is a summary of the level-of-service and vehicle queue analyses for the intersections within the study area.

Table 10
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Unsignalized Intersection/ Peak Hour/Movement	2015 Existing				2022 No-Build				2022 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Groton Road (Route 40) at Oak Hill Road												
Weekday Morning:												
Groton Road (Route 40) EB LT	5	7.8	A	0								
Groton Road (Route 40) EB TH/RT	607	0.0	A	0								
Groton Road (Route 40) WB LT	87	9.4	A	1								
Groton Road (Route 40) WB TH/RT	224	0.0	A	0								
Oak Hill Road NB LT/TH/RT	201	39.8	E	6								
Oak Hill Road SB LT	24	>50.0	F	2								
Oak Hill Road SB TH/RT	12	25.0	D	0								
Weekday Evening:												
Groton Road (Route 40) EB LT	2	8.7	A	0	See Signalized Intersections (Table 11)				See Signalized Intersections (Table 11)			
Groton Road (Route 40) EB TH/RT	398	0.0	A	0								
Groton Road (Route 40) WB LT	179	9.1	A	1								
Groton Road (Route 40) WB TH/RT	551	0.0	A	0								
Oak Hill Road NB LT/TH/RT	175	>50.0	F	7								
Oak Hill Road SB LT	29	>50.0	F	3								
Oak Hill Road SB TH/RT	11	28.0	D	1								
Saturday Midday:												
Groton Road (Route 40) EB LT	3	7.9	A	0								
Groton Road (Route 40) EB TH/RT	405	0.0	A	0								
Groton Road (Route 40) WB LT	151	8.8	A	1								
Groton Road (Route 40) WB TH/RT	275	0.0	A	0								
Oak Hill Road NB LT/TH/RT	232	22.2	C	4								
Oak Hill Road SB LT	10	>50.0	F	1								
Oak Hill Road SB TH/RT	10	11.6	B	0								
Groton Road (Route 40) at Commerce Way												
Weekday Morning:												
Groton Road (Route 40) EB LT/TH	729	0.0	A	0	821	0.0	A	0	822	0.0	A	0
Groton Road (Route 40) WB TH/RT	344	0.0	A	0	383	0.0	A	0	401	0.0	A	0
Commerce Way SB LT/RT	32	41.5	E	2	32	>50.0	F	2	50	>50.0	F	4
Weekday Evening:												
Groton Road (Route 40) EB LT/TH	522	0.1	A	0	586	0.1	A	0	587	0.1	A	0
Groton Road (Route 40) WB TH/RT	648	0.0	A	0	731	0.0	A	0	742	0.0	A	0
Commerce Way SB LT/RT	15	23.4	C	1	15	28.2	D	1	28	45.5	E	2
Saturday Midday:												
Groton Road (Route 40) EB LT/TH	560	0.0	A	0	630	0.0	A	0	631	0.0	A	0
Groton Road (Route 40) WB TH/RT	386	0.0	A	0	438	0.0	A	0	449	0.0	A	0
Commerce Way SB LT/RT	7	14.7	B	0	7	16.2	C	0	19	26.3	D	1

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level-of-Service.
[d]Queue length in vehicles.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements, TH = through movements, RT = right-turning movements.

Table 11
SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Signalized Intersection/Peak Hour/Movement	2015 Existing V/C[a]	2015 Existing Delay[b]	2015 Existing LOS[c]	2015 Existing Queue[d] 50th/95th	2022 No-Build V/C	2022 No-Build Delay	2022 No-Build LOS	2022 No-Build Queue 50th/95th	2022 Build V/C	2022 Build Delay	2022 Build LOS	2022 Build Queue 50th/95th
Groton Road (Route 40) at Oak Hill Road												
Weekday Morning:												
Groton Road (Route 40) EB LT					0.01	3.3	A	0/0	0.01	3.3	A	0/0
Groton Road (Route 40) EB TH/RT					0.86	26.0	C	9/17	0.86	26.1	C	9/17
Groton Road (Route 40) WB LT					0.37	7.1	A	1/1	0.37	7.1	A	1/1
Groton Road (Route 40) WB TH/RT					0.32	6.8	A	2/4	0.32	6.8	A	2/4
Oak Hill Road NB LT/TH/RT					0.71	19.1	B	1/3	0.71	19.1	B	1/3
Oak Hill Road SB LT/TH/RT					0.43	38.7	D	1/2	0.43	38.7	D	1/2
Overall					--	**19.3**	**B**	--	--	**19.4**	**B**	--
Weekday Evening:	See Unsignalized Intersections											
Groton Road (Route 40) EB LT	(Table 10)				0.01	4.0	A	0/0	0.01	4.0	A	0/0
Groton Road (Route 40) EB TH/RT					0.79	22.5	C	6/8	0.79	22.6	C	6/8
Groton Road (Route 40) WB LT					0.54	9.5	A	1/2	0.54	9.5	A	1/2
Groton Road (Route 40) WB TH/RT					0.66	13.2	B	5/16	0.66	13.2	B	5/16
Oak Hill Road NB LT/TH/RT					0.62	17.2	B	1/4	0.62	17.2	B	1/4
Oak Hill Road SB LT/TH/RT					0.43	30.0	C	1/2	0.43	30.1	C	1/2
Overall					--	**16.8**	**B**	--	--	**16.8**	**B**	--
Saturday Midday:												
Groton Road (Route 40) EB LT					0.01	4.7	A	0/0	0.01	4.7	A	0/0
Groton Road (Route 40) EB TH/RT					0.74	21.4	C	5/10	0.74	21.5	C	5/10
Groton Road (Route 40) WB LT					0.42	7.8	A	1/2	0.42	7.8	A	1/2
Groton Road (Route 40) WB TH/RT					0.37	8.9	A	2/6	0.37	8.9	A	2/6
Oak Hill Road NB LT/TH/RT					0.62	11.8	B	1/3	0.62	11.8	B	1/3
Oak Hill Road SB LT/TH/RT					0.16	18.0	B	0/1	0.16	18.0	B	0/1
Overall					--	**14.2**	**B**	--	--	**14.2**	**B**	--

[a]Volume-to-capacity ratio.
[b]Percentile delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue length in vehicles.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

Groton Road at Oak Hill Road

Under 2015 Existing conditions, the critical movements at this intersection (generally left-turns from the Oak Hill Road southbound approach), were shown to operate at LOS F during the weekday morning, weekday evening and Saturday midday peak hours. With the installation of a traffic control signal and associated geometric improvements as a part of the Groton Road/ Oak Hill Road Intersection Improvement Project (expected to be complete by 2022), the improved signalized intersection was shown to operate at an overall LOS B during the weekday morning, weekday evening and Saturday midday peak hours under 2022 No-Build and 2022 Build conditions, with no change in LOS for any movement shown to occur as a result of the addition of Project-related traffic.

Groton Road at Commerce Way (540 Groton Road Driveway)

Under 2015 Existing conditions, the critical movements at this intersection (left and right-turns from Commerce Way) were shown to operate at LOS E during the weekday morning peak-hour, at LOS C during the weekday evening peak-hour and at LOS B during the Saturday midday peak-hour. Under 2022 No-Build conditions, the critical movements were shown to degrade to LOS F during the weekday morning peak-hour, to LOS D during the weekday evening peak-hour and to LOS C during the Saturday midday peak-hour as a result of traffic-volume increases along Groton Road independent of the Project.

Under 2022 Build conditions, with the addition of Project-related traffic, the critical movements were shown to remain operating at LOS F during the weekday morning peak-hour and to degrade to LOS E during the weekday evening peak-hour (17.3 second increase in average motorist delay) and to LOS D during the Saturday midday peak-hour (10.1 second increase in average motorist delay). All movements along Groton Road were shown to operate at LOS A under all analysis conditions with negligible vehicle queuing. Vehicle queues exiting Commerce Way were shown to range from 0 to 4 vehicles, with increases of 0 to 2 vehicles predicted to occur as a result of the Project. The predicted vehicle queues can be contained along Commerce Way without impeding access or the flow of vehicles along Groton Road.

SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the intersection of Groton Road at Commerce Way in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)[24] requirements. Both stopping sight distance (SSD) and intersection sight distance (ISD) measurements were performed. In brief, SSD is the distance required by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. ISD or corner sight distance (CSD) is the sight distance required by a driver entering or crossing an intersecting roadway to perceive an on-coming vehicle and safely complete a turning or crossing maneuver with on-coming traffic. In accordance with AASHTO standards, if the measured ISD is at least equal to the required SSD value for the appropriate design speed, the intersection can operate in a safe manner. Table 12 presents the measured SSD and ISD at the subject intersection.

[24] Ibid 11.

Table 12
SIGHT DISTANCE MEASUREMENTS

Intersection/Sight Distance Measurement	Feet		
	Required Minimum[a]	ISD[b]	Measured
Groton Road at Commerce Way (540 Groton Road Driveway)			
Stopping Sight Distance:			
Groton Road approaching from the east	360	--	650+
Groton Road approaching from the west	360	--	650+
Intersection Sight Distance:			
Looking to the east from Commerce Way	360	430/500	650+
Looking to the west from Commerce Way	360	430/500	650+

[a]Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets,* 6th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011; and based on a 45 mph approach speed on Groton Road.

[b]Values shown are the intersection sight distance for a vehicle turning right/left exiting a roadway under STOP control such that motorists approaching the intersection on the major street should not need to adjust their travel speed to less than 70 percent of their initial approach speed.

As can be seen in Table 12, the available sight lines exceed the recommended minimum sight distance requirements for the Groton Road/Commerce Way intersection to function in a safe and efficient manner based on a 45 mph approach speed along Groton Road, consistent with the measured 85th percentile vehicle travel speed (41 mph) and 10 mph above the posted speed limit (35 mph).

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

VAI has completed a detailed assessment of the potential impacts on the transportation infrastructure associated with the proposed construction of a bituminous concrete manufacturing facility to be located at 540 Groton Road (Route 40) in Westford, Massachusetts. The following specific areas have been evaluated as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; under existing and future conditions, both with and without the Project. Based on this assessment, we have concluded the following with respect to the Project:

1. Based on the production of an average of 1,500 tons of product per day and consistent with the information contained in the Remand Order specific to the Project,[25] the Project is expected to generate approximately 250 vehicle trips on an average weekday and Saturday (125 vehicles entering and 125 exiting), with approximately 37 vehicle trips expected during the weekday morning peak-hour, 25 vehicle trips during the weekday evening peak-hour and 24 vehicle trips during the Saturday midday peak-hour;

2. The Project will not have a significant impact (increase) on motorist delays or vehicle queuing over Existing or anticipated future conditions without the Project (No-Build conditions), with no material impact on the flow of traffic along Groton Road shown to occur as a result of the Project;

3. No apparent safety deficiencies were noted with respect to the motor vehicle crash history at the Groton Road/Commerce Way intersection. The Groton Road/ Oak Hill Road intersection was found to have a motor vehicle crash rate above both the MassDOT statewide and District 3 averages for an unsignalized intersection, and the intersection was ranked as 98 on the top 100 high crash intersections for 2006-2008 in the Northern Middlesex Region.[26] Improvements are planned at this intersection by others that include geometric modifications and the installation of a traffic control signal, measures which will help to reduce the frequency of occurrence of angle-type collisions at the intersection (the predominant crash type reported); and

[25] Ibid 1.
[26] Ibid 6.

4. Lines of sight to and from the Groton Road/Commerce Way intersection were found to exceed the required minimum distance for the intersection to function in a safe and efficient manner based on a 45 mph approach speed along Groton Road, consistent with the measured 85th percentile vehicle travel speed (41 mph) and 10 mph above the posted speed limit (35 mph).

In consideration of the above, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with implementation of the recommendations that follow.

RECOMMENDATIONS

A detailed transportation improvement program has been developed that is designed to provide safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Project Access

Access to the Project site will be provided by way of Commerce Way, the existing driveway that serves 540 Groton Road, which will be improved in conjunction with the Project (discussion follows). All trucks, excepting local deliveries of bituminous concrete product, will be directed to exit to the east and to use the Route 3/Groton Road (Route 40) interchange (Exit 33). This is consistent with the current restriction for exiting truck traffic at the Project site driveway (signs indicating "No Right Turn", "Left Turn Only" and "All Trucks Must Turn Left" are posted for vehicles exiting the driveway that will serve the Project). The following recommendations are offered with respect to the design and operation of Commerce Way:

- Commerce Way will be reconstructed at its intersection with Groton Road to include the following enhancements:
  - Expansion of the island at the center of the driveway to separate and channelize (by way of a one-way slip lane) traffic entering the driveway from the east (westbound) from both exiting traffic and vehicles entering from the west (eastbound);
  - Providing a two-way drive on the west side of the expanded island to facilitate exiting traffic and vehicles entering from the west;
  - Installing new signs and pavement markings approaching Groton Road to delineate the expanded island; indicate the one-way entering direction of travel on the slip lane ("One-Way" and "Do Not Enter" signs to be installed); provide a marked centerline on the two-way portion of the driveway; and install a STOP-sign and marked STOP-line for traffic exiting the driveway to Groton Road; and
  - Repaving the Commerce Way approach and installing/upgrading the existing drainage system.
- The existing signs indicating "No Right Turn", "Left Turn Only" and "All Trucks Must Turn Left" should be retained to reinforce the turn restriction for exiting truck traffic.

- All signs and pavement markings to be installed on Commerce Way and within the Project site shall conform to the applicable standards of the *Manual on Uniform Traffic Control Devices* (MUTCD).[27]

- "Trucks Entering Ahead" warning signs should be installed on Groton Road approaching Commerce Way (both directions).

- Signs and landscaping to be installed along the Commerce Way, internal to the Project site and at the Groton Road/Commerce Way intersection should be designed and maintained so as not to restrict lines of sight.

- A maintenance plan will be established in consultation with the Town of Westford Department of Public Works that will entail a schedule for routine sweeping of Commerce Way and Groton Road approaching and departing Commerce Way.

- Trucks delivering bituminous concrete product manufactured at the Project site to destinations within the Town of Westford shall be given a color coded tag that is to be displayed in a prominent location within the cab of the truck and is readily observable from the outside of the vehicle.

Traffic Monitoring and Reporting Program

The Project proponent has agreed to limit the volume of traffic attributable to the Project to no more than 250 vehicle trips per day. In order to document compliance with this limitation and consistent with the prior recommendation of the Town's independent review consultant, a post-development traffic monitoring program will be implemented. The monitoring program will consist of the following elements:

i) Provide a complete log of deliveries and materials imported to and exported from the Project to include all bituminous concrete sales, excepting material transferred within the Project site (i.e., trips that remain internal to the larger property that contains the Project);

ii) Provide daily employee time card verification showing number of employees working on a daily basis; and

iii) Maintaining a daily log of all other visitor trips (i.e., salesman, etc.).

It is the intention of the Project proponent to produce daily activity counts and to report these to the Town of Westford on a monthly basis.

With implementation of the above recommendations, safe and efficient access will be provided to the Project site and the Project can be accommodated within the confines of the existing and improved transportation system.

[27] Ibid 12.

APPENDIX

AUTOMATIC TRAFFIC RECORDER COUNTS
MANUAL TURNING MOVEMENT COUNTS
SEASONAL ADJUSTMENT DATA
PUBLIC TRANSPORTATION SCHEDULES
VEHICLE TRAVEL SPEED DATA
MASSDOT CRASH RATE WORKSHEETS
BACKGROUND DEVELOPMENT WORKSHEETS
GENERAL BACKGROUND TRAFFIC GROWTH
TRIP-GENERATION CALCULATIONS
CAPACITY ANALYSIS WORKSHEETS
CONCEPT PLAN – GROTON ROAD (ROUTE 40) AT COMMERCE WAY

AUTOMATIC TRAFFIC RECORDER COUNTS

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Site Driveway
City/State: Westford, MA

Site Code: 69510001
6951VOL

Start Time	22-Jan-15 Thu	EB Morning	EB Afternoon	Hour Totals Morning	Hour Totals Afternoon	WB Morning	WB Afternoon	Hour Totals Morning	Hour Totals Afternoon	Combined Totals Morning	Combined Totals Afternoon
12:00		1	86			14	94				
12:15		5	102			8	61				
12:30		2	81			4	80				
12:45		3	73	11	342	4	85	30	320	41	662
01:00		2	88			3	89				
01:15		1	76			8	81				
01:30		1	95			0	101				
01:45		1	69	5	328	4	98	15	369	20	697
02:00		0	88			3	83				
02:15		5	89			2	103				
02:30		0	90			1	109				
02:45		2	103	7	370	2	124	8	419	15	789
03:00		2	87			3	128				
03:15		1	102			5	159				
03:30		4	128			3	141				
03:45		6	122	13	439	2	144	13	572	26	1011
04:00		5	129			1	164				
04:15		8	126			5	145				
04:30		11	120			3	149				
04:45		23	104	47	479	7	155	16	613	63	1092
05:00		34	130			13	159				
05:15		49	126			11	161				
05:30		74	134			21	156				
05:45		95	117	252	507	22	188	67	664	319	1171
06:00		85	97			27	162				
06:15		83	107			32	170				
06:30		110	87			51	187				
06:45		128	68	406	359	75	112	185	631	591	990
07:00		135	67			90	117				
07:15		169	65			81	108				
07:30		166	49			101	75				
07:45		135	37	605	218	75	74	347	374	952	592
08:00		174	28			88	76				
08:15		170	25			74	75				
08:30		181	35			66	90				
08:45		211	21	736	109	96	54	324	295	1060	404
09:00		176	26			70	58				
09:15		156	29			67	55				
09:30		136	19			52	58				
09:45		113	17	581	91	60	54	249	225	830	316
10:00		99	25			55	31				
10:15		100	19			59	39				
10:30		92	21			63	38				
10:45		96	12	387	77	67	31	244	139	631	216
11:00		80	8			68	27				
11:15		82	16			72	25				
11:30		89	6			83	21				
11:45		114	9	365	39	94	21	317	94	682	133
Total		3415	3358			1815	4715			5230	8073
Percent		50.4%	49.6%			27.8%	72.2%			39.3%	60.7%

Total 13,303

Ave month = 13,303 x 1.03
= 13,702

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA

6951VOL2

Start Time	06-Feb-15 Fri	EB Morning	EB Afternoon	Hour Totals Morning	Hour Totals Afternoon	WB Morning	WB Afternoon	Hour Totals Morning	Hour Totals Afternoon	Combined Totals Morning	Combined Totals Afternoon
12:00		3	106			15	62				
12:15		6	96			17	76				
12:30		1	77			5	90				
12:45		1	80	11	359	6	80	43	308	54	667
01:00		2	97			6	95				
01:15		1	88			6	92				
01:30		0	63			3	92				
01:45		1	68	4	316	2	91	17	370	21	686
02:00		0	82			4	101				
02:15		2	108			3	93				
02:30		4	91			2	118				
02:45		1	103	7	384	1	127	10	439	17	823
03:00		3	103			3	127				
03:15		3	85			2	131				
03:30		6	116			5	129				
03:45		2	138	14	442	5	137	15	524	29	966
04:00		8	103			7	117				
04:15		11	111			4	111				
04:30		16	144			11	118				
04:45		24	118	59	476	9	116	31	462	90	938
05:00		30	135			11	108				
05:15		50	119			10	112				
05:30		72	124			19	121				
05:45		67	151	219	529	16	139	56	480	275	1009
06:00		76	163			33	134				
06:15		90	114			41	118				
06:30		92	161			47	129				
06:45		134	123	392	561	68	120	189	501	581	1062
07:00		119	122			74	125				
07:15		152	89			78	99				
07:30		164	75			61	110				
07:45		163	73	598	359	84	96	297	430	895	789
08:00		185	73			65	127				
08:15		171	31			80	68				
08:30		158	47			74	75				
08:45		172	41	686	192	105	72	324	342	1010	534
09:00		140	27			72	77				
09:15		137	32			54	67				
09:30		119	31			70	82				
09:45		124	35	520	125	42	64	238	290	758	415
10:00		101	27			52	59				
10:15		104	22			56	67				
10:30		119	31			57	71				
10:45		74	39	398	119	66	104	231	301	629	420
11:00		94	25			77	33				
11:15		89	27			51	25				
11:30		83	11			84	19				
11:45		106	13	372	76	66	33	278	110	650	186
Total		3280	3938			1729	4557			5009	8495
Percent		45.4%	54.6%			27.5%	72.5%			37.1%	62.9%

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA

6951VOL2

Start Time	07-Feb-15 Sat	EB Morning	EB Afternoon	Hour Totals Morning	Hour Totals Afternoon	WB Morning	WB Afternoon	Hour Totals Morning	Hour Totals Afternoon	Combined Totals Morning	Combined Totals Afternoon
12:00		9	115			17	103				
12:15		11	122			15	86				
12:30		4	140			11	117				
12:45		3	123	27	500	15	94	58	400	85	900
01:00		4	130			10	111				
01:15		6	108			10	127				
01:30		4	111			6	116				
01:45		1	96	15	445	9	109	35	463	50	908
02:00		2	116			8	119				
02:15		2	95			3	117				
02:30		5	91			4	129				
02:45		5	101	14	403	5	113	20	478	34	881
03:00		0	95			1	124				
03:15		0	115			1	110				
03:30		1	101			4	133				
03:45		3	85	4	396	7	120	13	487	17	883
04:00		7	94			3	104				
04:15		5	81			2	97				
04:30		7	99			7	118				
04:45		6	79	25	353	8	108	20	427	45	780
05:00		7	100			7	107				
05:15		12	84			1	112				
05:30		11	95			10	109				
05:45		13	92	43	371	14	82	32	410	75	781
06:00		16	90			14	89				
06:15		24	79			8	81				
06:30		28	87			17	72				
06:45		41	72	109	328	25	93	64	335	173	663
07:00		49	76			21	65				
07:15		73	59			19	57				
07:30		66	50			22	66				
07:45		60	43	248	228	32	69	94	257	342	485
08:00		70	33			31	63				
08:15		78	52			46	59				
08:30		74	25			44	58				
08:45		90	35	312	145	52	54	173	234	485	379
09:00		90	24			57	45				
09:15		112	27			64	43				
09:30		128	30			65	50				
09:45		101	27	431	108	64	54	250	192	681	300
10:00		128	25			64	42				
10:15		130	39			60	32				
10:30		117	31			75	41				
10:45		159	18	534	113	98	50	297	165	831	278
11:00		138	30			102	29				
11:15		123	24			96	54				
11:30		135	18			97	44				
11:45		138	14	534	86	127	17	422	144	956	230
Total		2296	3476			1478	3992			3774	7468
Percent		39.8%	60.2%			27.0%	73.0%			33.6%	66.4%
Grand Total		8301	10310			4641	12633			12942	22943
Percent		44.6%	55.4%			26.9%	73.1%			36.1%	63.9%
ADT		ADT 11,962		AADT 11,962							

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA

6951VOL2

Start Time	02-Feb-15 EB	02-Feb-15 WB	Tue EB	Tue WB	Wed EB	Wed WB	Thu EB	Thu WB	Fri EB	Fri WB	Sat EB	Sat WB	Sun EB	Sun WB	Week Average EB	Week Average WB
12:00 AM	*	*	*	*	*	*	22	29	11	43	27	58	*	*	20	43
01:00	*	*	*	*	*	*	3	13	4	17	15	35	*	*	7	22
02:00	*	*	*	*	*	*	8	10	7	10	14	20	*	*	10	13
03:00	*	*	*	*	*	*	12	6	14	15	4	13	*	*	10	11
04:00	*	*	*	*	*	*	56	19	59	31	25	20	*	*	47	23
05:00	*	*	*	*	*	*	250	71	219	56	43	32	*	*	171	53
06:00	*	*	*	*	*	*	368	148	392	189	109	64	*	*	290	134
07:00	*	*	*	*	*	*	492	249	598	297	248	94	*	*	446	213
08:00	*	*	*	*	*	*	**497**	**270**	**686**	**324**	312	173	*	*	**498**	256
09:00	*	*	*	*	*	*	448	225	520	238	431	250	*	*	466	238
10:00	*	*	*	*	*	*	298	185	398	231	**534**	297	*	*	410	238
11:00	*	*	*	*	*	*	271	209	372	278	534	**422**	*	*	392	**303**
12:00 PM	*	*	*	*	*	*	272	206	359	308	**500**	400	*	*	377	305
01:00	*	*	*	*	*	*	254	279	316	370	445	463	*	*	338	371
02:00	*	*	*	*	*	*	314	333	384	439	403	478	*	*	367	417
03:00	*	*	*	*	*	*	326	440	442	**524**	396	**487**	*	*	388	484
04:00	*	*	*	*	*	*	372	473	476	462	353	427	*	*	400	454
05:00	*	*	*	*	*	*	**415**	**589**	529	480	371	410	*	*	**438**	**493**
06:00	*	*	*	*	*	*	365	538	**561**	501	328	335	*	*	418	458
07:00	*	*	*	*	*	*	243	460	359	430	228	257	*	*	277	382
08:00	*	*	*	*	*	*	119	304	192	342	145	234	*	*	152	293
09:00	*	*	*	*	*	*	108	225	125	290	108	192	*	*	114	236
10:00	*	*	*	*	*	*	72	172	119	301	113	165	*	*	101	213
11:00	*	*	*	*	*	*	36	65	76	110	86	144	*	*	66	106
Lane	0	0	0	0	0	0	5621	5518	7218	6286	5772	5470	0	0	6203	5759
Day	0		0		0		11139		13504		11242		0		11962	
AM Peak	-	-	-	-	-	-	08:00	08:00	08:00	08:00	10:00	11:00	-	-	08:00	11:00
Vol.	-	-	-	-	-	-	497	270	686	324	534	422	-	-	498	303
PM Peak	-	-	-	-	-	-	17:00	17:00	18:00	15:00	12:00	15:00	-	-	17:00	17:00
Vol.	-	-	-	-	-	-	415	589	561	524	500	487	-	-	438	493

Comb. Total	0	0	0	11139	13504	11242	0	11962
ADT	ADT 11,962	AADT 11,962		↑ Not Used		Ave month Adj. 11242 x 1.01 = 11,354		

MANUAL TURNING MOVEMENT COUNTS

Accurate Counts

978-664-2565

N/S Street : Oak Hill Road
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510002
Site Code : 69510002
Start Date : 1/22/2015
Page No : 1

Groups Printed- Cars - Trucks

	Oak Hill Rd From North			Route 40 From East			Oak Hill Rd From South			Route 40 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00 AM	3	3	0	16	55	13	4	11	41	1	108	11	266
07:15 AM	6	3	0	17	58	9	6	6	39	0	112	13	269
07:30 AM	7	4	1	28	57	7	3	6	30	2	125	14	284
07:45 AM	5	2	0	17	40	6	11	6	37	0	132	4	260
Total	21	12	1	78	210	35	24	29	147	3	477	42	1079
08:00 AM	5	5	1	18	54	8	3	8	30	1	123	9	265
08:15 AM	6	3	1	14	34	8	3	0	40	1	130	14	254
08:30 AM	7	2	0	25	37	3	4	3	41	1	149	10	282
08:45 AM	5	0	0	27	68	4	7	7	48	2	148	5	321
Total	23	10	2	84	193	23	17	18	159	5	550	38	1122
Grand Total	44	22	3	162	403	58	41	47	306	8	1027	80	2201
Apprch %	63.8	31.9	4.3	26	64.7	9.3	10.4	11.9	77.7	0.7	92.1	7.2	
Total %	2	1	0.1	7.4	18.3	2.6	1.9	2.1	13.9	0.4	46.7	3.6	
Cars	44	22	3	159	393	55	39	47	303	8	1015	78	2166
% Cars	100	100	100	98.1	97.5	94.8	95.1	100	99	100	98.8	97.5	98.4
Trucks	0	0	0	3	10	3	2	0	3	0	12	2	35
% Trucks	0	0	0	1.9	2.5	5.2	4.9	0	1	0	1.2	2.5	1.6

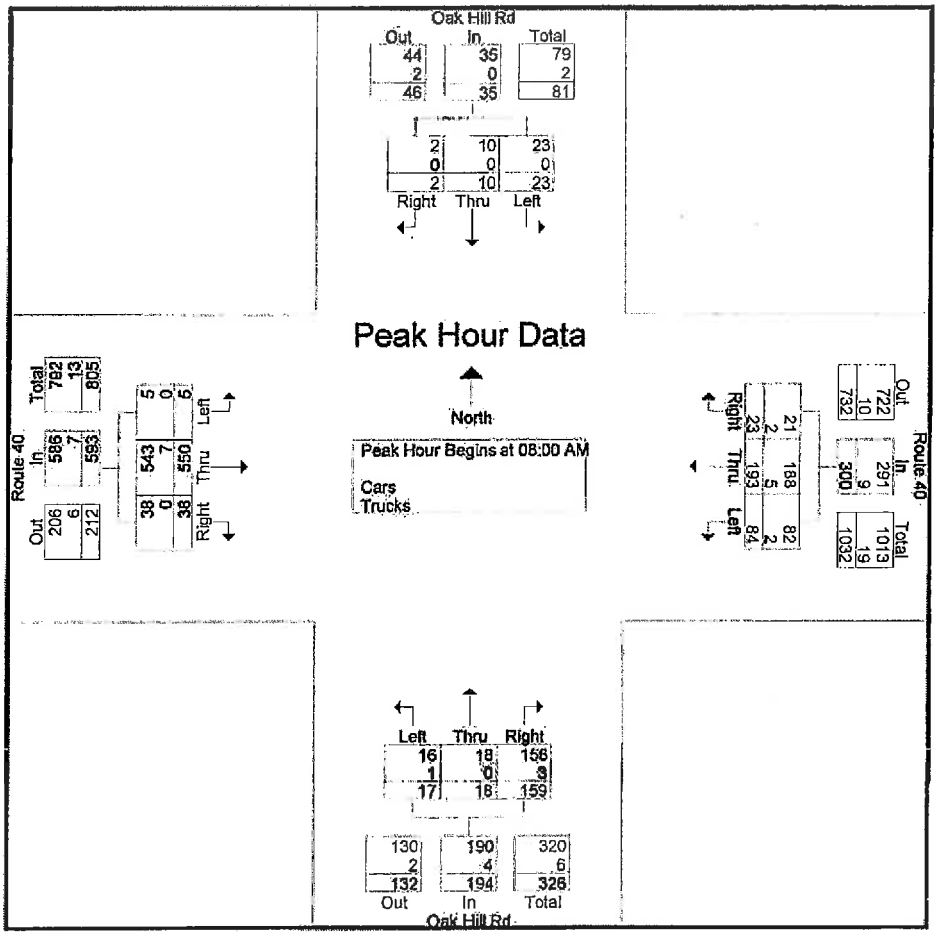
Accurate Counts

978-664-2565

N/S Street : Oak Hill Road
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510002
Site Code : 69510002
Start Date : 1/22/2015
Page No : 2

	Oak Hill Rd From North				Route 40 From East				Oak Hill Rd From South				Route 40 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 08:00 AM																	
08:00 AM	5	**5**	**1**	**11**	18	54	**8**	80	3	**8**	30	41	1	123	9	133	265
08:15 AM	6	3	1	10	14	34	8	56	3	0	40	43	1	130	**14**	145	254
08:30 AM	**7**	2	0	9	25	37	3	65	4	3	41	48	1	**149**	10	**160**	282
08:45 AM	5	0	0	5	**27**	**68**	4	**99**	**7**	7	**48**	**62**	**2**	148	5	155	**321**
Total Volume	23	10	2	35	84	193	23	300	17	18	159	194	5	550	38	593	1122
% App. Total	65.7	28.6	5.7		28	64.3	7.7		8.8	9.3	82		0.8	92.7	6.4		
PHF	.821	.500	.500	.795	.778	.710	.719	.758	.607	.563	.828	.782	.625	.923	.679	.927	.874
Cars	23	10	2	35	82	188	21	291	16	18	156	190	5	543	38	586	1102
% Cars	100	100	100	100	97.6	97.4	91.3	97.0	94.1	100	98.1	97.9	100	98.7	100	98.8	98.2
Trucks	0	0	0	0	2	5	2	9	1	0	3	4	0	7	0	7	20
% Trucks	0	0	0	0	2.4	2.6	8.7	3.0	5.9	0	1.9	2.1	0	1.3	0	1.2	1.8



Accurate Counts
978-664-2565

N/S Street : Oak Hill Road
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510002
Site Code : 69510002
Start Date : 1/22/2015

Groups Printed- Trucks

	Oak Hill Rd From North			Route 40 From East			Oak Hill Rd From South			Route 40 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00 AM	0	0	0	0	0	1	1	0	0	0	1	1	4
07:15 AM	0	0	0	1	2	0	0	0	0	0	2	0	5
07:30 AM	0	0	0	0	2	0	0	0	0	0	1	1	4
07:45 AM	0	0	0	0	1	0	0	0	0	0	1	0	2
Total	0	0	0	1	5	1	1	0	0	0	5	2	15
08:00 AM	0	0	0	1	2	2	0	0	1	0	2	0	8
08:15 AM	0	0	0	0	1	0	0	0	0	0	2	0	3
08:30 AM	0	0	0	1	1	0	0	0	1	0	3	0	6
08:45 AM	0	0	0	0	1	0	1	0	1	0	0	0	3
Total	0	0	0	2	5	2	1	0	3	0	7	0	20
Grand Total	0	0	0	3	10	3	2	0	3	0	12	2	35
Apprch %	0	0	0	18.8	62.5	18.8	40	0	60	0	85.7	14.3	
Total %	0	0	0	8.6	28.6	8.6	5.7	0	8.6	0	34.3	5.7	

Accurate Counts
978-664-2565

N/S Street : Oak Hill Road
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510002
Site Code : 69510002
Start Date : 1/22/2015
Page No : 10

Groups Printed- Bikes Peds

	Oak Hill Rd From North				Route 40 From East				Oak Hill Rd From South				Route 40 From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0				
Total %																	0	0	

Accurate Counts

978-664-2565

N/S Street : Oak Hill Road
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510002
Site Code : 69510002
Start Date : 1/22/2015
Page No : 1

Groups Printed- Cars - Trucks

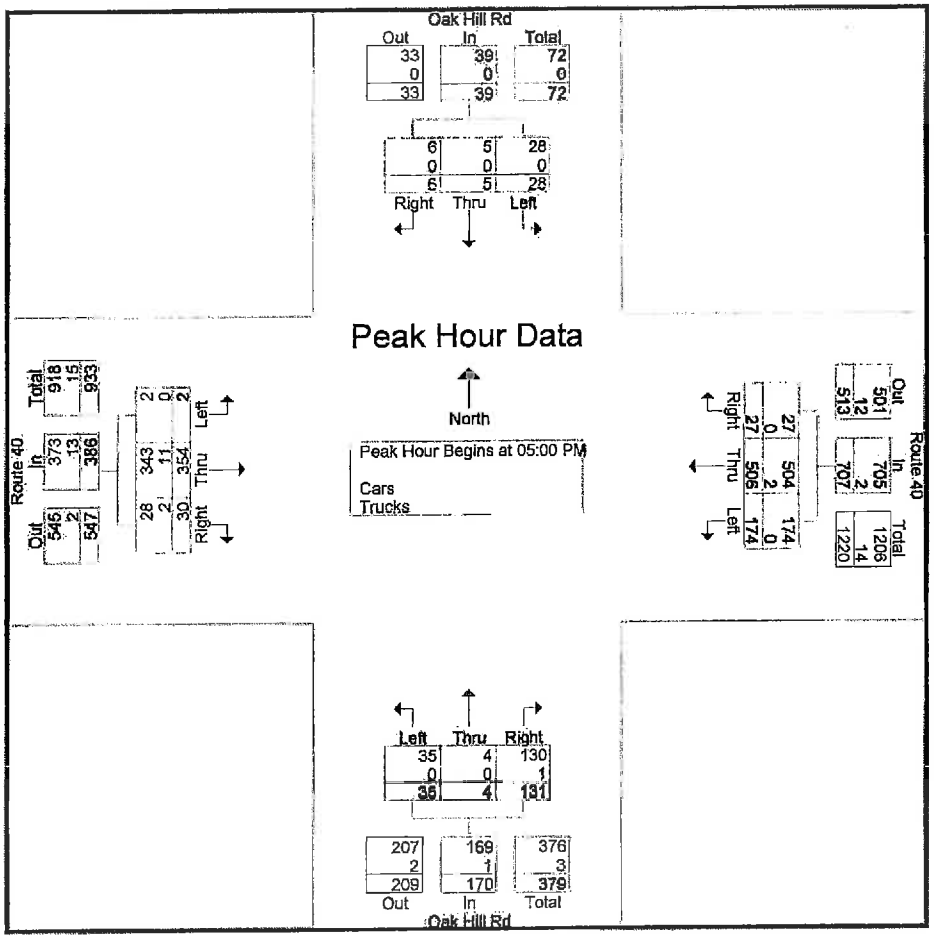
	Oak Hill Rd From North			Route 40 From East			Oak Hill Rd From South			Route 40 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
04:00 PM	7	1	1	47	108	4	7	3	33	0	80	6	297
04:15 PM	4	2	0	38	108	6	2	1	34	0	86	9	290
04:30 PM	5	2	0	38	97	12	6	3	36	0	83	12	294
04:45 PM	5	1	6	48	90	12	6	0	24	3	73	4	272
Total	21	6	7	171	403	34	21	7	127	3	322	31	1153
05:00 PM	7	3	2	43	119	7	11	0	28	0	79	4	303
05:15 PM	11	2	1	47	144	9	3	2	34	1	88	11	353
05:30 PM	7	0	3	43	131	7	8	0	40	0	77	3	319
05:45 PM	3	0	0	41	112	4	13	2	29	1	110	12	327
Total	28	5	6	174	506	27	35	4	131	2	354	30	1302
Grand Total	49	11	13	345	909	61	56	11	258	5	676	61	2455
Apprch %	67.1	15.1	17.8	26.2	69.1	4.6	17.2	3.4	79.4	0.7	91.1	8.2	
Total %	2	0.4	0.5	14.1	37	2.5	2.3	0.4	10.5	0.2	27.5	2.5	
Cars	49	11	13	345	905	61	56	11	256	5	661	58	2431
% Cars	100	100	100	100	99.6	100	100	100	99.2	100	97.8	95.1	99
Trucks	0	0	0	0	4	0	0	0	2	0	15	3	24
% Trucks	0	0	0	0	0.4	0	0	0	0.8	0	2.2	4.9	1

Accurate Counts
978-664-2565

N/S Street : Oak Hill Road
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510002
Site Code : 69510002
Start Date : 1/22/2015
Page No : 2

	Oak Hill Rd From North				Route 40 From East				Oak Hill Rd From South				Route 40 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	7	**3**	2	12	43	119	7	169	11	0	28	39	0	79	4	83	303
05:15 PM	**11**	2	1	**14**	**47**	**144**	**9**	**200**	3	**2**	34	39	**1**	88	11	100	**353**
05:30 PM	7	0	**3**	10	43	131	7	181	8	0	**40**	**48**	0	77	3	80	319
05:45 PM	3	0	0	3	41	112	4	157	**13**	2	29	44	1	**110**	**12**	**123**	327
Total Volume	28	5	6	39	174	506	27	707	35	4	131	170	2	354	30	386	1302
% App. Total	71.8	12.8	15.4		24.6	71.6	3.8		20.6	2.4	77.1		0.5	91.7	7.8		
PHF	.636	.417	.500	.696	.926	.878	.750	.884	.673	.500	.819	.885	.500	.805	.625	.785	.922
Cars	28	5	6	39	174	504	27	705	35	4	130	169	2	343	28	373	1286
% Cars	100	100	100	100	100	99.6	100	99.7	100	100	99.2	99.4	100	96.9	93.3	96.6	98.8
Trucks	0	0	0	0	0	2	0	2	0	0	1	1	0	11	2	13	16
% Trucks	0	0	0	0	0	0.4	0	0.3	0	0	0.8	0.6	0	3.1	6.7	3.4	1.2



Accurate Counts

978-664-2565

N/S Street : Oak Hill Road
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510002
Site Code : 69510002
Start Date : 1/22/2015
Page No : 7

Groups Printed- Trucks

	Oak Hill Rd From North			Route 40 From East			Oak Hill Rd From South			Route 40 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	1	1	2
04:15 PM	0	0	0	0	1	0	0	0	0	0	2	0	3
04:30 PM	0	0	0	0	1	0	0	0	0	0	0	0	1
04:45 PM	0	0	0	0	0	0	0	0	1	0	1	0	2
Total	0	0	0	0	2	0	0	0	1	0	4	1	8
05:00 PM	0	0	0	0	1	0	0	0	0	0	1	1	3
05:15 PM	0	0	0	0	1	0	0	0	1	0	6	0	8
05:30 PM	0	0	0	0	0	0	0	0	0	0	4	0	4
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	1	1
Total	0	0	0	0	2	0	0	0	1	0	11	2	16
Grand Total	0	0	0	0	4	0	0	0	2	0	15	3	24
Apprch %	0	0	0	0	100	0	0	0	100	0	83.3	16.7	
Total %	0	0	0	0	16.7	0	0	0	8.3	0	62.5	12.5	

Accurate Counts
978-664-2565

N/S Street : Oak Hill Road
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510002
Site Code : 69510002
Start Date : 1/22/2015
Page No : 10

Groups Printed- Bikes Peds

	Oak Hill Rd From North				Route 40 From East				Oak Hill Rd From South				Route 40 From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0				
Total %																	0	0	

Accurate Counts

978-664-2565

N/S Street : Oak Hill Road
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 695100S2
Site Code : 69510002
Start Date : 1/31/2015
Page No : 1

Groups Printed- Cars - Trucks

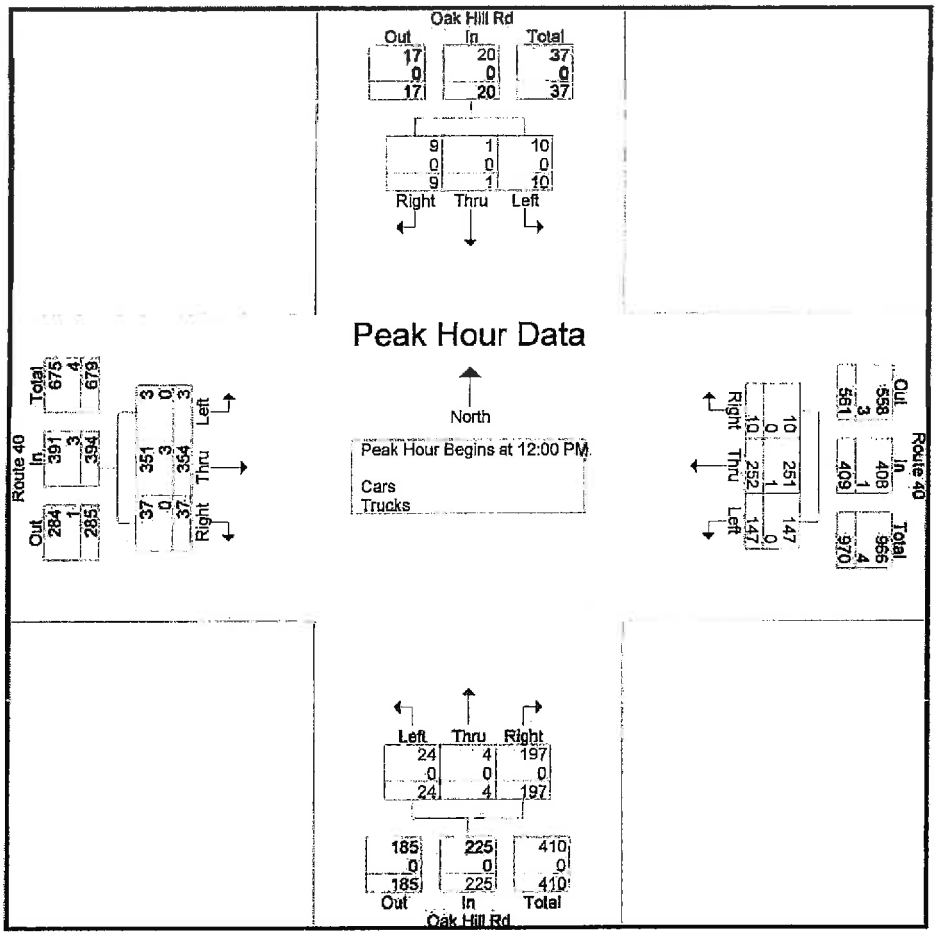
	Oak Hill Rd From North			Route 40 From East			Oak Hill Rd From South			Route 40 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
11:00 AM	1	2	6	36	69	3	7	2	47	3	71	7	254
11:15 AM	2	1	5	38	80	3	13	1	47	2	81	15	288
11:30 AM	1	3	1	23	57	2	10	1	40	2	76	9	225
11:45 AM	2	2	4	28	75	0	11	0	45	8	79	6	260
Total	6	8	16	125	281	8	41	4	179	15	307	37	1027
12:00 PM	3	0	2	37	70	3	5	1	35	0	100	9	265
12:15 PM	1	0	3	38	52	2	8	1	52	0	98	13	268
12:30 PM	3	1	2	32	54	4	3	0	57	2	80	10	248
12:45 PM	3	0	2	40	76	1	8	2	53	1	76	5	267
Total	10	1	9	147	252	10	24	4	197	3	354	37	1048
01:00 PM	0	0	0	36	68	0	7	0	59	0	73	4	247
01:15 PM	1	0	1	36	60	0	5	1	40	1	60	7	212
01:30 PM	2	1	4	38	62	2	5	4	31	0	62	7	218
01:45 PM	7	2	2	40	67	4	5	3	40	3	81	4	258
Total	10	3	7	150	257	6	22	8	170	4	276	22	935
Grand Total	26	12	32	422	790	24	87	16	546	22	937	96	3010
Apprch %	37.1	17.1	45.7	34.1	63.9	1.9	13.4	2.5	84.1	2.1	88.8	9.1	
Total %	0.9	0.4	1.1	14	26.2	0.8	2.9	0.5	18.1	0.7	31.1	3.2	
Cars	26	11	31	420	785	23	87	15	543	22	930	96	2989
% Cars	100	91.7	96.9	99.5	99.4	95.8	100	93.8	99.5	100	99.3	100	99.3
Trucks	0	1	1	2	5	1	0	1	3	0	7	0	21
% Trucks	0	8.3	3.1	0.5	0.6	4.2	0	6.2	0.5	0	0.7	0	0.7

Accurate Counts

978-664-2565

File Name : 695100S2
Site Code : 69510002
Start Date : 1/31/2015
Page No : 2

Start Time	Oak Hill Rd From North				Route 40 From East				Oak Hill Rd From South				Route 40 From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 12:00 PM																	
12:00 PM	**3**	0	2	5	37	70	3	110	5	1	35	41	0	**100**	9	109	265
12:15 PM	1	0	**3**	4	38	52	2	92	**8**	1	52	61	0	98	**13**	**111**	**268**
12:30 PM	3	**1**	2	**6**	32	54	**4**	90	3	0	**57**	60	**2**	80	10	92	248
12:45 PM	3	0	2	5	**40**	**76**	1	**117**	8	**2**	53	**63**	1	76	5	82	267
Total Volume	10	1	9	20	147	252	10	409	24	4	197	225	3	354	37	394	1048
% App. Total	50	5	45		35.9	61.6	2.4		10.7	1.8	87.6		0.8	89.8	9.4		
PHF	.833	.250	.750	.833	.919	.829	.625	.874	.750	.500	.864	.893	.375	.885	.712	.887	.978
Cars	10	1	9	20	147	251	10	408	24	4	197	225	3	351	37	391	1044
% Cars	100	100	100	100	100	99.6	100	99.8	100	100	100	100	100	99.2	100	99.2	99.6
Trucks	0	0	0	0	0	1	0	1	0	0	0	0	0	3	0	3	4
% Trucks	0	0	0	0	0	0.4	0	0.2	0	0	0	0	0	0.8	0	0.8	0.4



Accurate Counts

978-664-2565

File Name : 695100S2
Site Code : 69510002
Start Date : 1/31/2015
Page No : 7

Groups Printed- Trucks

	Oak Hill Rd From North			Route 40 From East			Oak Hill Rd From South			Route 40 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
11:00 AM	0	1	0	0	1	0	0	1	2	0	0	0	5
11:15 AM	0	0	1	1	0	1	0	0	0	0	1	0	4
11:30 AM	0	0	0	0	1	0	0	0	0	0	0	0	1
11:45 AM	0	0	0	0	1	0	0	0	0	0	1	0	2
Total	0	1	1	1	3	1	0	1	2	0	2	0	12
12:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	1
12:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	1
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	0	0	1	0	0	0	0	0	1	0	2
Total	0	0	0	0	1	0	0	0	0	0	3	0	4
01:00 PM	0	0	0	1	0	0	0	0	1	0	0	0	2
01:15 PM	0	0	0	0	1	0	0	0	0	0	1	0	2
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
01:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	1
Total	0	0	0	1	1	0	0	0	1	0	2	0	5
Grand Total	0	1	1	2	5	1	0	1	3	0	7	0	21
Apprch %	0	50	50	25	62.5	12.5	0	25	75	0	100	0	
Total %	0	4.8	4.8	9.5	23.8	4.8	0	4.8	14.3	0	33.3	0	

Accurate Counts

978-664-2565

File Name : 69510082
Site Code : 69510002
Start Date : 1/31/2015
Page No : 10

Groups Printed- Bikes Peds

	Oak Hill Rd From North				Route 40 From East				Oak Hill Rd From South				Route 40 From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu Total	Inclu Total	Int. Total
11:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0				
Total %																	0	0	

Accurate Counts

978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510001
Site Code : 69510001
Start Date : 1/22/2015
Page No : 1

Groups Printed- Cars - Trucks

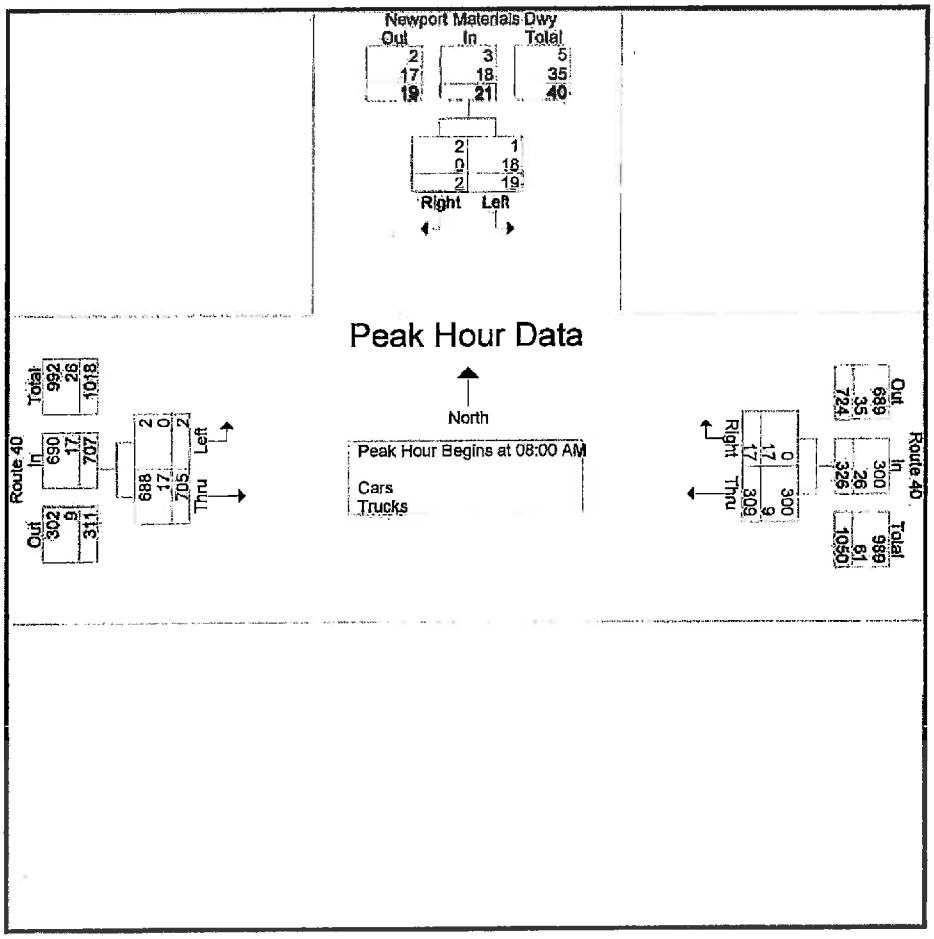
	Newport Materials Dwy From North		Route 40 From East		Route 40 From West		
Start Time	Left	Right	Thru	Right	Left	Thru	Int. Total
07:00 AM	4	0	82	5	1	148	240
07:15 AM	1	0	79	2	0	156	238
07:30 AM	1	0	97	2	0	160	260
07:45 AM	3	0	77	4	0	155	239
Total	9	0	335	13	1	619	977
08:00 AM	3	1	86	4	0	158	252
08:15 AM	5	1	61	6	2	160	235
08:30 AM	3	0	69	5	0	197	274
08:45 AM	8	0	93	2	0	190	293
Total	19	2	309	17	2	705	1054
Grand Total	28	2	644	30	3	1324	2031
Apprch %	93.3	6.7	95.5	4.5	0.2	99.8	
Total %	1.4	0.1	31.7	1.5	0.1	65.2	
Cars	1	2	627	6	3	1302	1941
% Cars	3.6	100	97.4	20	100	98.3	95.6
Trucks	27	0	17	24	0	22	90
% Trucks	96.4	0	2.6	80	0	1.7	4.4

Accurate Counts
978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510001
Site Code : 69510001
Start Date : 1/22/2015
Page No : 2

	Newport Materials Dwy From North			Route 40 From East			Route 40 From West			
Start Time	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 08:00 AM										
08:00 AM	3	1	4	86	4	90	0	158	158	252
08:15 AM	5	1	6	61	6	67	2	160	162	235
08:30 AM	3	0	3	69	5	74	0	197	197	274
08:45 AM	8	0	8	93	2	95	0	190	190	293
Total Volume	19	2	21	309	17	326	2	705	707	1054
% App. Total	90.5	9.5		94.8	5.2		0.3	99.7		
PHF	.594	.500	.656	.831	.708	.858	.250	.895	.897	.899
Cars	1	2	3	300	0	300	2	688	690	993
% Cars	5.3	100	14.3	97.1	0	92.0	100	97.6	97.6	94.2
Trucks	18	0	18	9	17	26	0	17	17	61
% Trucks	94.7	0	85.7	2.9	100	8.0	0	2.4	2.4	5.8



Accurate Counts

978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510001
Site Code : 69510001
Start Date : 1/22/2015
Page No : 7

Groups Printed- Trucks

	Newport Materials Dwy From North		Route 40 From East		Route 40 From West		
Start Time	Left	Right	Thru	Right	Left	Thru	Int. Total
07:00 AM	4	0	2	0	0	1	7
07:15 AM	1	0	3	1	0	2	7
07:30 AM	1	0	1	2	0	1	5
07:45 AM	3	0	2	4	0	1	10
Total	9	0	8	7	0	5	29
08:00 AM	3	0	4	4	0	5	16
08:15 AM	4	0	2	6	0	4	16
08:30 AM	3	0	1	5	0	6	15
08:45 AM	8	0	2	2	0	2	14
Total	18	0	9	17	0	17	61
Grand Total	27	0	17	24	0	22	90
Apprch %	100	0	41.5	58.5	0	100	
Total %	30	0	18.9	26.7	0	24.4	

Accurate Counts

978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510001
Site Code : 69510001
Start Date : 1/22/2015

Groups Printed- Bikes Peds

	Newport Materials Dwy From North			Route 40 From East			Route 40 From West					
Start Time	Left	Right	Peds	Thru	Right	Peds	Left	Thru	Peds	Exclu. Total	Inclu. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0		0	0		0	0				
Total %										0	0	

Accurate Counts
978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510001
Site Code : 69510001
Start Date : 1/22/2015
Page No : 1

Groups Printed- Cars - Trucks

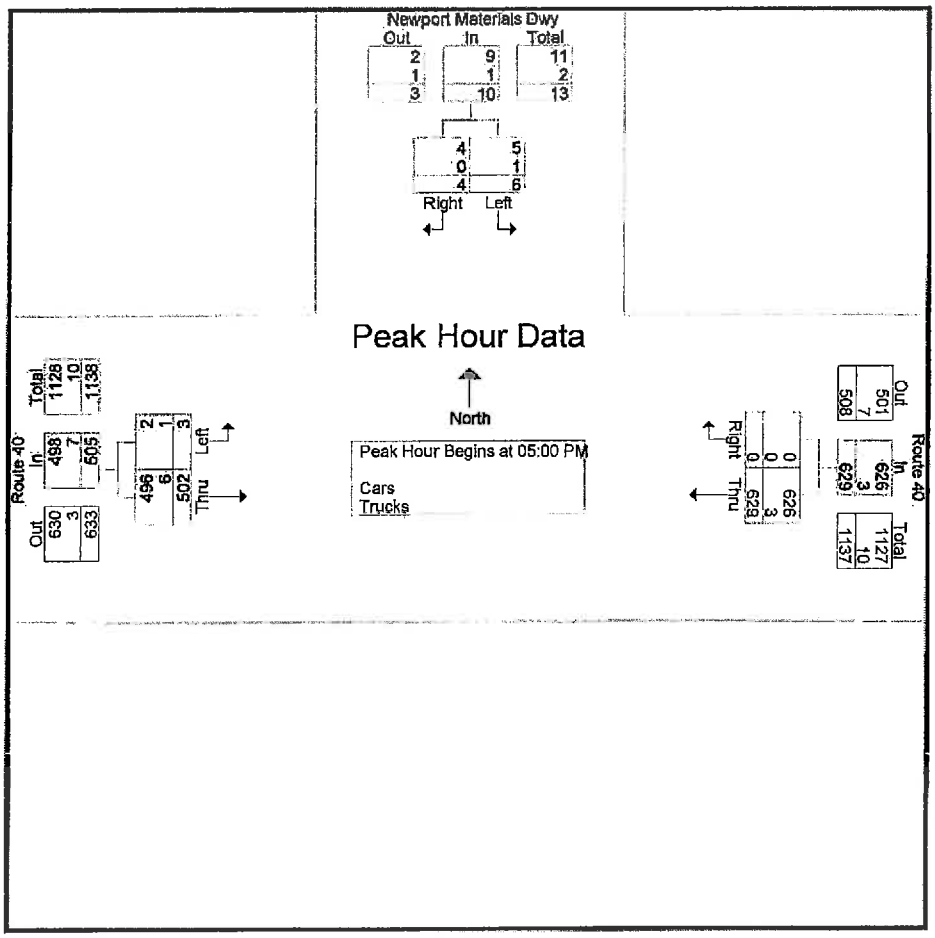
	Newport Materials Dwy From North		Route 40 From East		Route 40 From West		
Start Time	Left	Right	Thru	Right	Left	Thru	Int. Total
04:00 PM	1	1	139	0	0	126	267
04:15 PM	3	0	170	5	0	124	302
04:30 PM	4	0	146	0	0	123	273
04:45 PM	1	0	140	0	0	110	251
Total	9	1	595	5	0	483	1093
05:00 PM	2	2	159	0	1	116	280
05:15 PM	1	1	175	0	1	122	300
05:30 PM	3	1	155	0	1	126	286
05:45 PM	0	0	140	0	0	138	278
Total	6	4	629	0	3	502	1144
Grand Total	15	5	1224	5	3	985	2237
Apprch %	75	25	99.6	0.4	0.3	99.7	
Total %	0.7	0.2	54.7	0.2	0.1	44	
Cars	12	5	1218	3	2	974	2214
% Cars	80	100	99.5	60	66.7	98.9	99
Trucks	3	0	6	2	1	11	23
% Trucks	20	0	0.5	40	33.3	1.1	1

Accurate Counts
978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510001
Site Code : 69510001
Start Date : 1/22/2015
Page No : 2

	Newport Materials Dwy From North			Route 40 From East			Route 40 From West			
Start Time	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 05:00 PM										
05:00 PM	2	**2**	**4**	159	0	159	**1**	116	117	280
05:15 PM	1	1	2	**175**	0	**175**	1	122	123	**300**
05:30 PM	**3**	1	4	155	0	155	1	126	127	286
05:45 PM	0	0	0	140	0	140	0	**138**	**138**	278
Total Volume	6	4	10	629	0	629	3	502	505	1144
% App. Total	60	40		100	0		0.6	99.4		
PHF	.500	.500	.625	.899	.000	.899	.750	.909	.915	.953
Cars	5	4	9	626	0	626	2	496	498	1133
% Cars	83.3	100	90.0	99.5	0	99.5	66.7	98.8	98.6	99.0
Trucks	1	0	1	3	0	3	1	6	7	11
% Trucks	16.7	0	10.0	0.5	0	0.5	33.3	1.2	1.4	1.0



Accurate Counts

978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510001
Site Code : 69510001
Start Date : 1/22/2015
Page No : 7

Groups Printed- Trucks

	Newport Materials Dwy From North		Route 40 From East		Route 40 From West		
Start Time	Left	Right	Thru	Right	Left	Thru	Int. Total
04:00 PM	0	0	0	0	0	3	3
04:15 PM	0	0	1	2	0	1	4
04:30 PM	2	0	2	0	0	0	4
04:45 PM	0	0	0	0	0	1	1
Total	2	0	3	2	0	5	12
05:00 PM	0	0	1	0	0	0	1
05:15 PM	0	0	1	0	1	4	6
05:30 PM	1	0	0	0	0	2	3
05:45 PM	0	0	1	0	0	0	1
Total	1	0	3	0	1	6	11
Grand Total	3	0	6	2	1	11	23
Apprch %	100	0	75	25	8.3	91.7	
Total %	13	0	26.1	8.7	4.3	47.8	

Accurate Counts
978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 69510001
Site Code : 69510001
Start Date : 1/22/2015
Page No : 10

Groups Printed- Bikes Peds

	Newport Materials Dwy From North			Route 40 From East			Route 40 From West					
Start Time	Left	Right	Peds	Thru	Right	Peds	Left	Thru	Peds	Exclu. Total	Inclu. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0		0	0		0	0				
Total %										0	0	

Accurate Counts
978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 695100S1
Site Code : 69510001
Start Date : 1/31/2015
Page No : 1

Groups Printed- Cars - Trucks

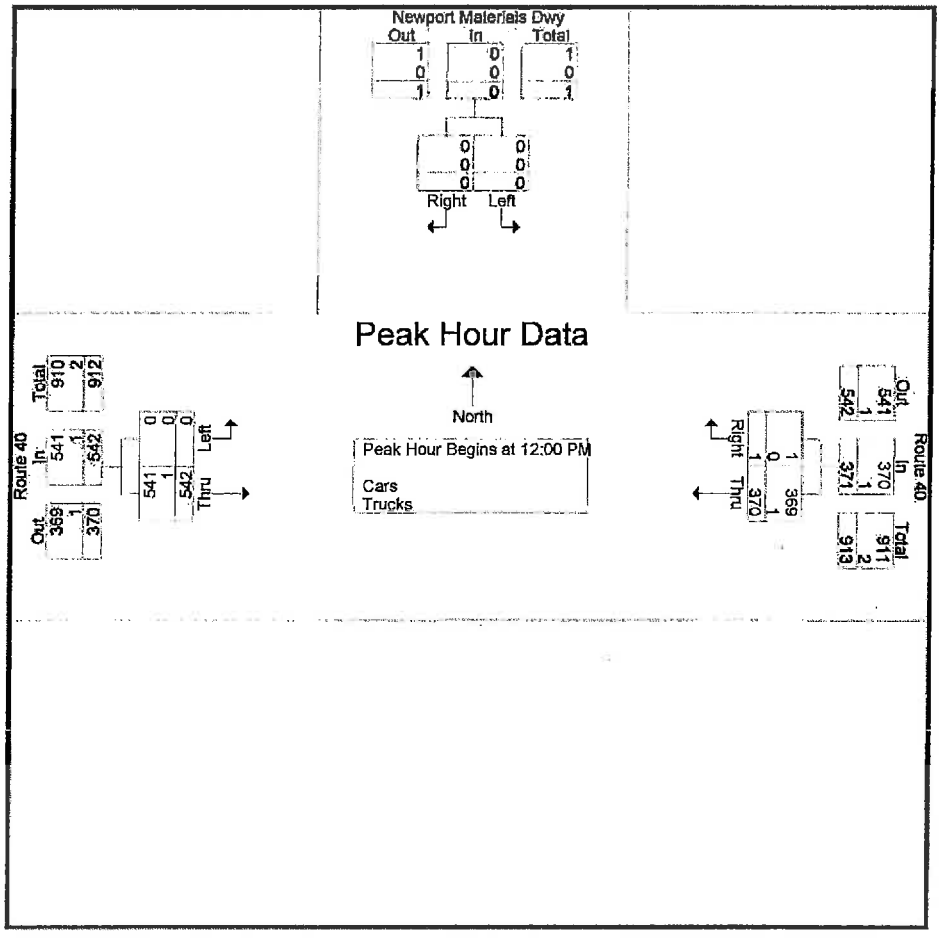
	Newport Materials Dwy From North		Route 40 From East		Route 40 From West		
Start Time	Left	Right	Thru	Right	Left	Thru	Int. Total
11:00 AM	0	1	98	0	1	124	224
11:15 AM	0	1	108	0	0	129	238
11:30 AM	1	0	80	0	0	121	202
11:45 AM	0	0	102	0	0	124	226
Total	1	2	388	0	1	498	890
12:00 PM	0	0	95	0	0	140	235
12:15 PM	0	0	84	1	0	147	232
12:30 PM	0	0	85	0	0	128	213
12:45 PM	0	0	106	0	0	127	233
Total	0	0	370	1	0	542	913
01:00 PM	0	0	99	0	0	132	231
01:15 PM	0	0	90	0	0	92	182
01:30 PM	0	0	101	0	0	97	198
01:45 PM	0	1	111	0	0	116	228
Total	0	1	401	0	0	437	839
Grand Total	1	3	1159	1	1	1477	2642
Apprch %	25	75	99.9	0.1	0.1	99.9	
Total %	0	0.1	43.9	0	0	55.9	
Cars	0	3	1157	1	1	1471	2633
% Cars	0	100	99.8	100	100	99.6	99.7
Trucks	1	0	2	0	0	6	9
% Trucks	100	0	0.2	0	0	0.4	0.3

Accurate Counts
978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 695100S1
Site Code : 69510001
Start Date : 1/31/2015
Page No : 2

	Newport Materials Dwy From North			Route 40 From East			Route 40 From West			
Start Time	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 01:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 12:00 PM										
12:00 PM	0	0	0	95	0	95	0	140	140	**235**
12:15 PM	0	0	0	84	**1**	85	0	**147**	**147**	232
12:30 PM	0	0	0	85	0	85	0	128	128	213
12:45 PM	0	0	0	**106**	0	**106**	0	127	127	233
Total Volume	0	0	0	370	1	371	0	542	542	913
% App. Total	0	0		99.7	0.3		0	100		
PHF	.000	.000	.000	.873	.250	.875	.000	.922	.922	.971
Cars	0	0	0	369	1	370	0	541	541	911
% Cars	0	0	0	99.7	100	99.7	0	99.8	99.8	99.8
Trucks	0	0	0	1	0	1	0	1	1	2
% Trucks	0	0	0	0.3	0	0.3	0	0.2	0.2	0.2



Accurate Counts
978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 695100S1
Site Code : 69510001
Start Date : 1/31/2015
Page No : 7

Groups Printed- Trucks

	Newport Materials Dwy From North		Route 40 From East		Route 40 From West		
Start Time	Left	Right	Thru	Right	Left	Thru	Int. Total
11:00 AM	0	0	0	0	0	0	0
11:15 AM	0	0	0	0	0	1	1
11:30 AM	1	0	1	0	0	1	3
11:45 AM	0	0	0	0	0	1	1
Total	1	0	1	0	0	3	5
12:00 PM	0	0	0	0	0	0	0
12:15 PM	0	0	0	0	0	0	0
12:30 PM	0	0	1	0	0	1	2
12:45 PM	0	0	0	0	0	0	0
Total	0	0	1	0	0	1	2
01:00 PM	0	0	0	0	0	1	1
01:15 PM	0	0	0	0	0	0	0
01:30 PM	0	0	0	0	0	0	0
01:45 PM	0	0	0	0	0	1	1
Total	0	0	0	0	0	2	2
Grand Total	1	0	2	0	0	6	9
Apprch %	100	0	100	0	0	100	
Total %	11.1	0	22.2	0	0	66.7	

Accurate Counts
978-664-2565

N/S Street : Newport Materials Driveway
E/W Street : Route 40
City/State : Westford, MA
Weather : Clear

File Name : 695100S1
Site Code : 69510001
Start Date : 1/31/2015
Page No : 10

Groups Printed- Bikes Peds

	Newport Materials Dwy From North			Route 40 From East			Route 40 From West					
Start Time	Left	Right	Peds	Thru	Right	Peds	Left	Thru	Peds	Exclu. Total	Inclu. Total	Int. Total
11:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
11:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
11:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
11:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
01:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0		0	0		0	0				
Total %										0	0	

SEASONAL ADJUSTMENT DATA

MASSACHUSETTS HIGHWAY DEPARTMENT - STATEWIDE TRAFFIC DATA COLLECTION

2011 WEEKDAY SEASONAL FACTORS *

* Note: These are weekday factors. The average of the factors for the year will not equal 1, as weekend data are not considered.

FACTOR GROUP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GROUP 1 - WEST INTERSTATE	0.98	0.93	0.90	0.89	0.90	0.88	0.91	0.90	0.89	0.89	0.93	0.95
Use group 2 for R5, R6, & R0 GROUP 2 - RURAL MAJOR COLLECTOR (R-5)	1.12	1.12	1.07	0.99	0.91	0.90	0.86	0.86	0.92	0.93	1.01	1.05
GROUP 3A - RECREATIONAL **(1-4) See below	1.26	1.25	1.20	1.06	0.96	0.89	0.76	0.76	0.92	0.99	1.08	1.14
GROUP 3B - RECREATIONAL ***(5) See below	1.22	1.26	1.22	1.08	0.96	0.90	0.72	0.74	0.97	1.02	1.14	1.15
GROUP 4 - I-495 INTERSTATE	1.02	1.00	1.00	0.96	0.92	0.89	0.85	0.83	0.93	0.96	1.01	1.03
GROUP 5 - EAST INTERSTATE	1.04	1.00	0.96	0.93	0.92	0.91	0.91	0.89	0.93	0.93	0.96	1.01
Use group 6 for U2, U3, U5, U6, U0, R2, & R3 GROUP 6 - URBAN ARTERIALS, COLLECTORS & RURAL ARTERIALS (R-2, R-3)	1.03	1.01	0.96	0.92	0.91	0.90	0.92	0.92	0.93	0.92	0.97	0.97
GROUP 7 - I-84 PROXIMITY (STAS. 17,3921)	1.24	1.24	1.15	1.04	0.99	1.00	0.93	0.89	1.05	1.05	1.05	1.12
GROUP 8 - I-295 PROXIMITY (STA. 6590)	1.00	0.99	0.95	0.92	0.94	0.91	0.93	0.92	0.95	0.94	0.97	0.95
GROUP 9 - I-195 PROXIMITY (STA. 7)	1.13	1.05	1.03	0.95	0.89	0.87	0.86	0.79	0.88	0.91	0.99	1.03

RECREATIONAL: (ALL YEARS)

**GROUP 3A:
1. CAPE COD (ALL TOWNS)
2.PLYMOUTH(SOUTH OF RTE.3A)

7014, 7079,7080,7090,7091,7092,7093,7094,7095,7096,7097,7108,7178
3.MARTHA'S VINEYARD
4.NANTUCKET

***GROUP 3B:
5.PERMANENTS 2 & 189
1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,
1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,
1105,1106,1107,1108,1113,1114,1116,2196,2197,2198

2011 AXLE CORRECTION FACTORS

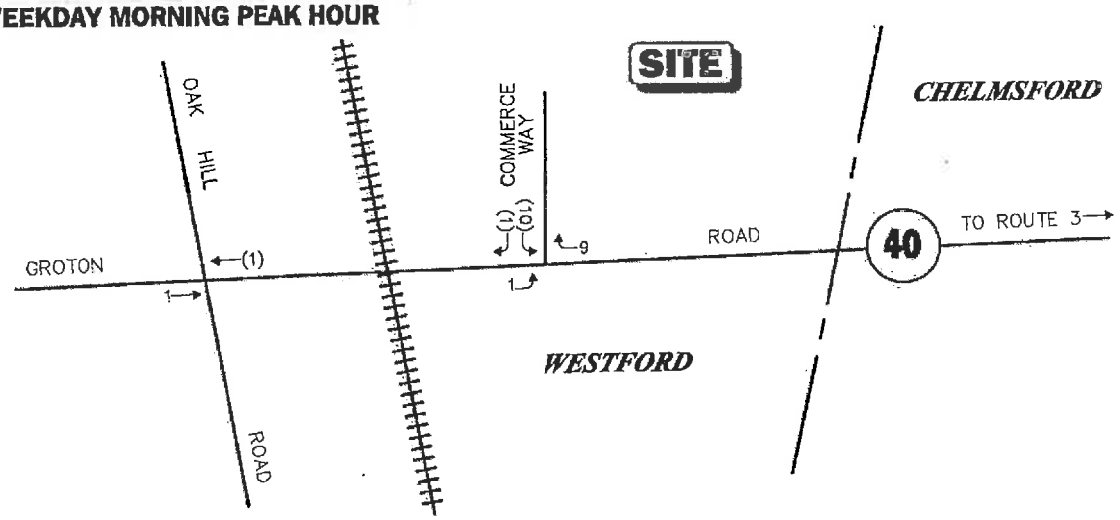
ROAD INVENTORY FUNCTIONAL CLASSIFICATION	AXLE CORRECTION FACTOR
RURAL	
1	0.95
2	0.97
3	0.98
0,5,6	0.98
URBAN	
1	0.96
2	0.98
3	0.98
5	0.98
0,6	0.99
I-84	0.90

Apply I-84 factor to stations: 3290,3929

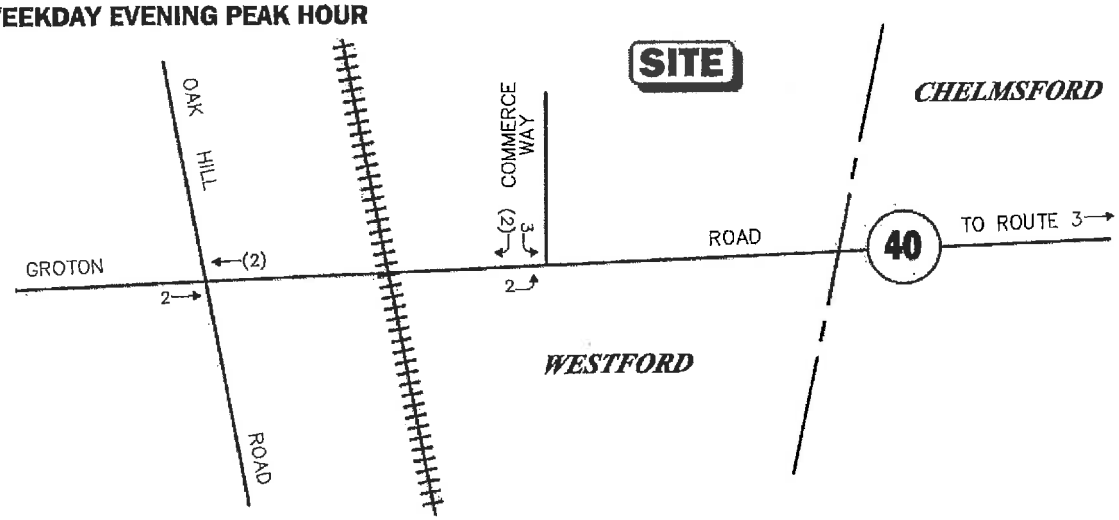
ROUND OFF

0 - 999.....10
> 1,000.....100

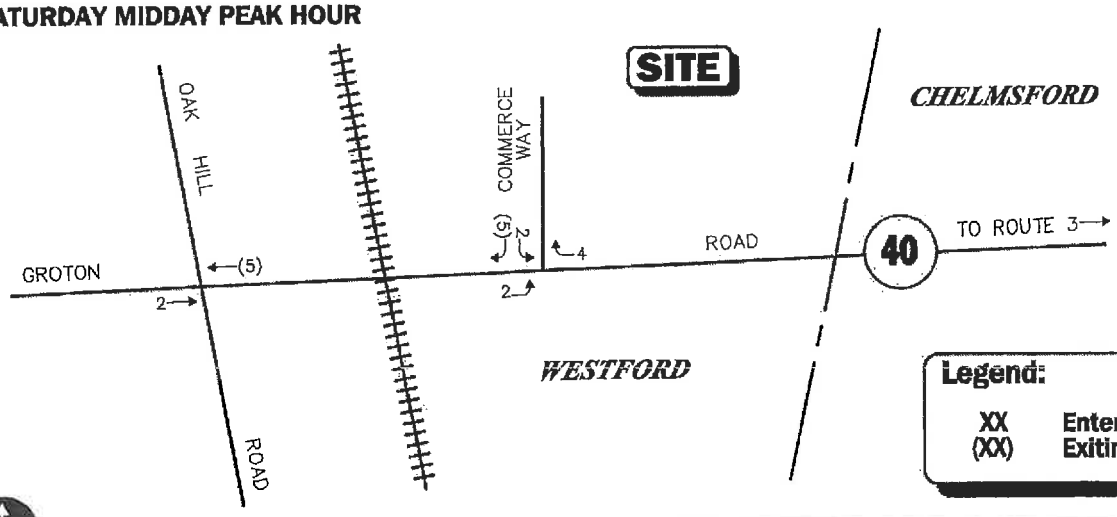
WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



SATURDAY MIDDAY PEAK HOUR



Not To Scale

Figure A-1

Vanasse & Associates, Inc.

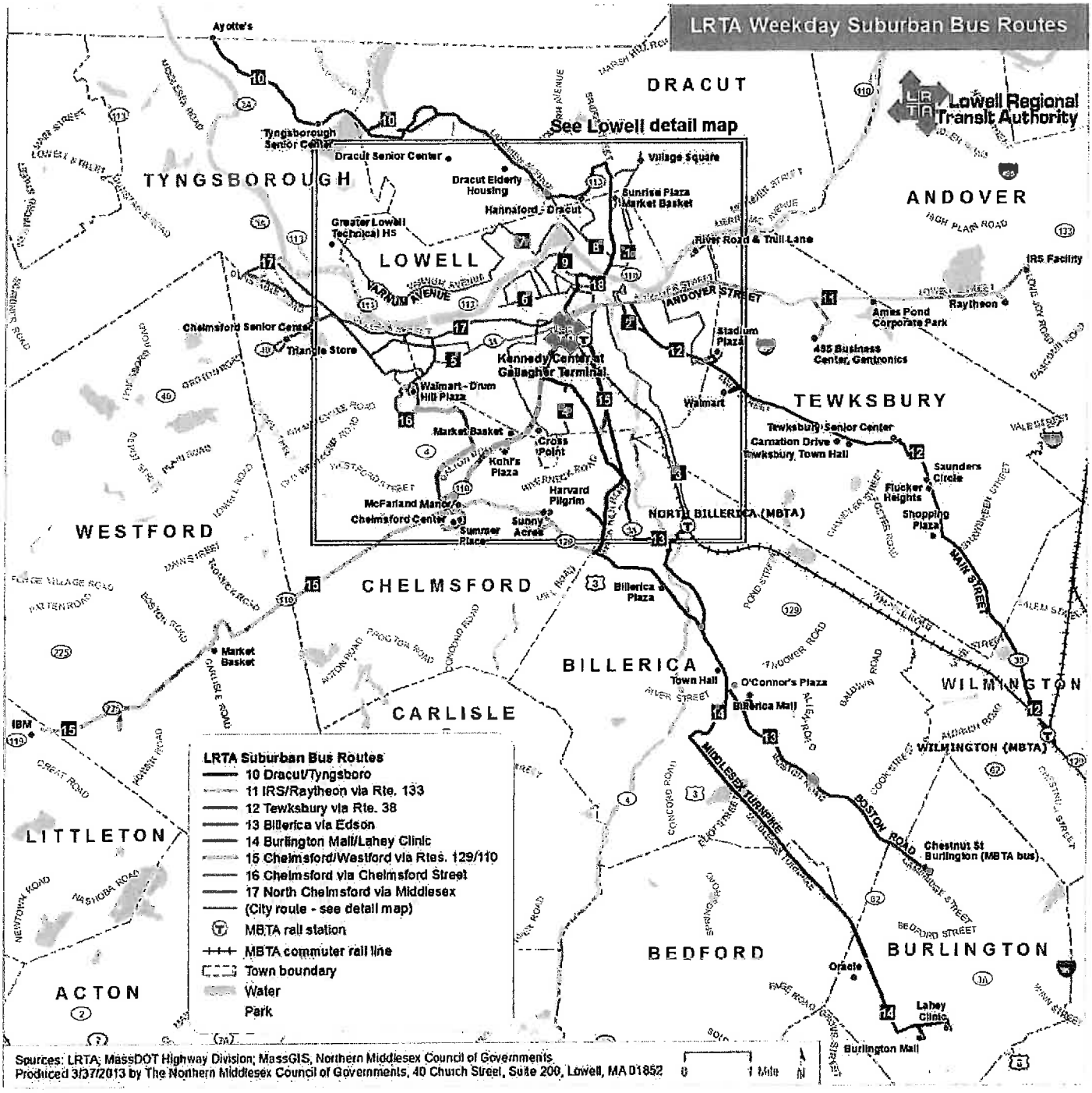
Peak Construction Season Adjustment for Existing On-Site Uses Peak Hour Traffic Volumes

PUBLIC TRANSPORTATION SCHEDULES

Lowell Regional Transit Authority

Weekday System Map

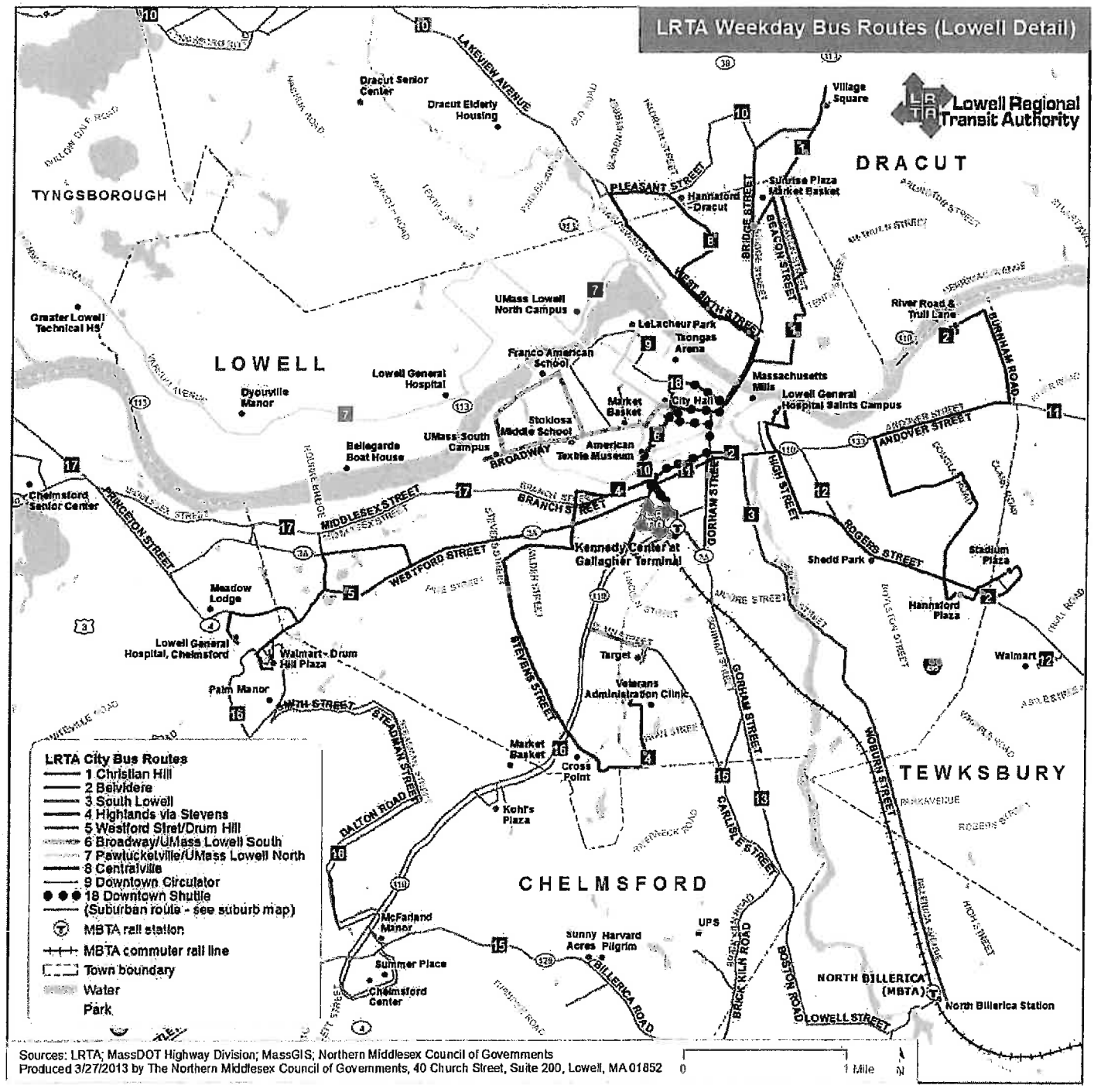
Last Updated: 3/27/13



Lowell Regional Transit Authority

Weekday System Map – Lowell Detail Map

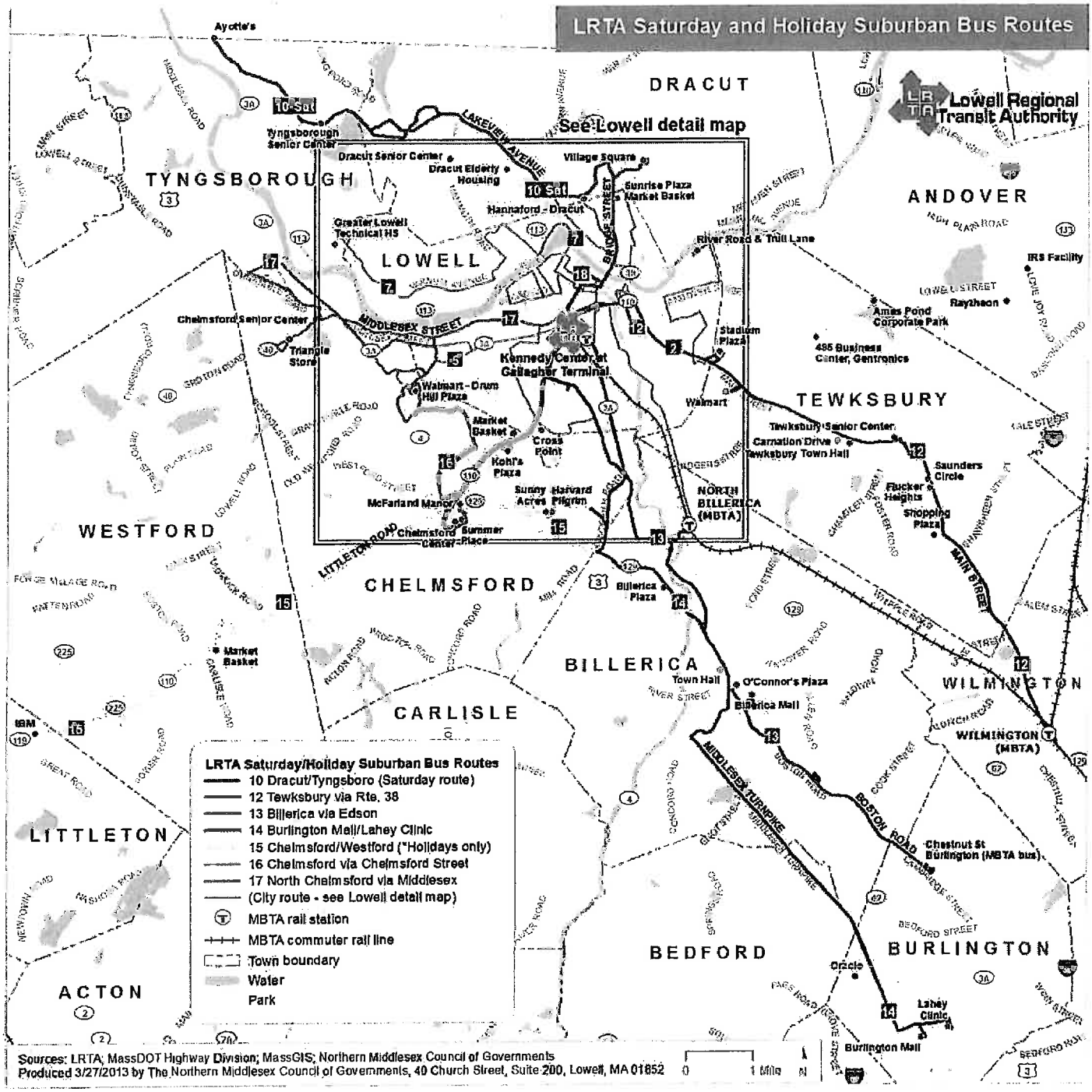
Last Updated: 3/27/13



Lowell Regional Transit Authority

Saturday System Map

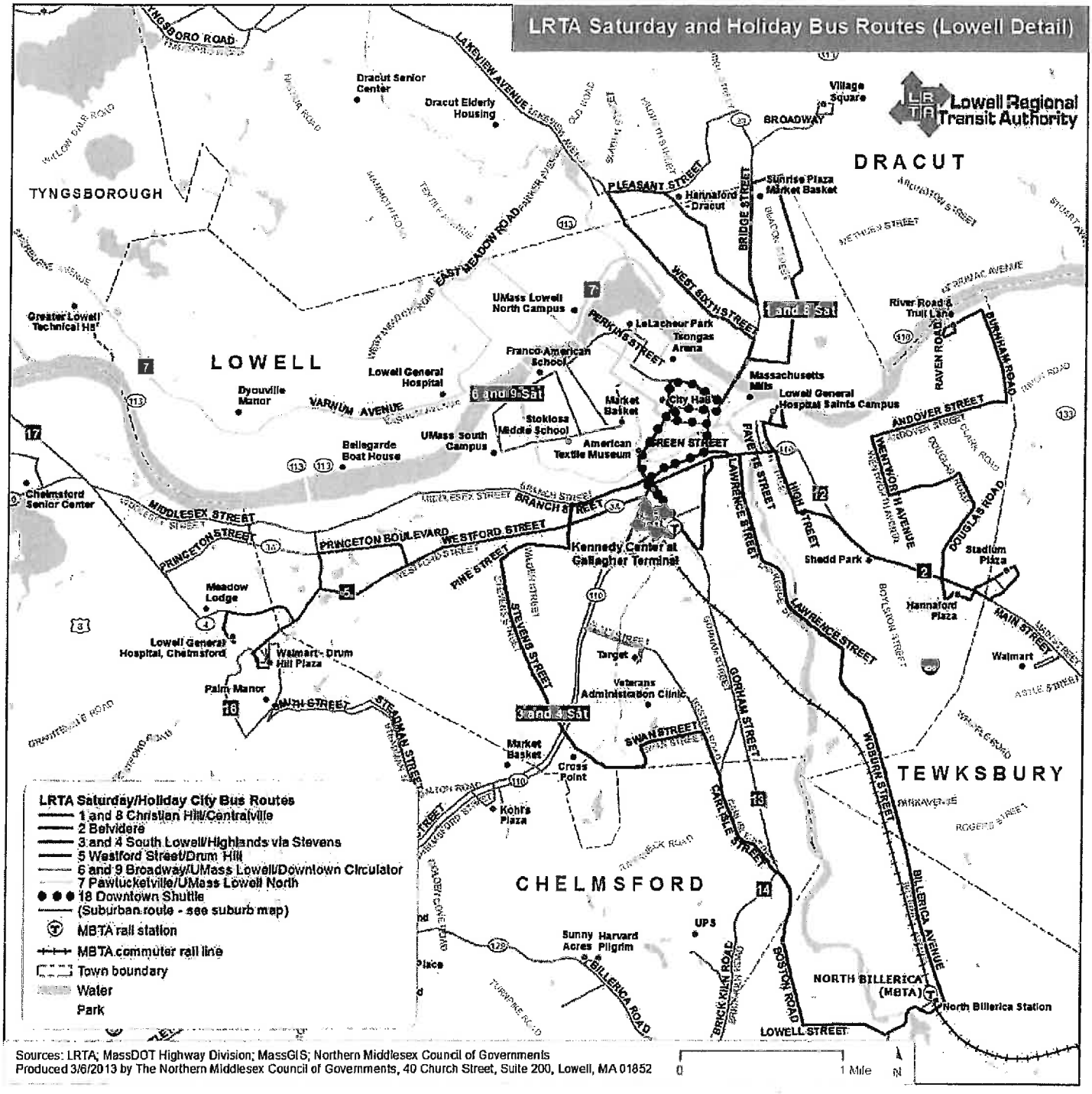
Last Updated: 3/27/13



Lowell Regional Transit Authority

Weekday System Map – Lowell Detail Map

Last Updated: 3/27/13



15 Chelmsford\Westford Via Rte 129/110

Please visit lrta.com or call (978) 452-6161 for more information

Weekday Schedule — Outbound

	1 Kennedy Center Gallagher	2 Carlisle St & Gorham St	3 UPS	4 Alpha Rd	5 Harvard Pilgrim Vanguard	6 Chelmsford Center	7 Littleton Rd & Hunt Rd	8 Kidder Road	9 Nashoba Tech	10 Hampton Inn Technology Drive	11 Westford Valley Market Place	12 Westford Regency Hotel	13 Residence Inn	14 IBM
AM	6:45	6:50	6:55	6:59	7:02	7:06	7:09	7:10	7:12	7:14	7:17	7:20	7:21	7:30
	8:15	8:20	8:25	8:29	8:32	8:36	8:39	8:40	8:42	8:44	8:47	8:50	8:51	9:00
	9:45	9:50	9:55	9:59	10:02	10:06	10:09	10:10	10:12	10:14	10:17	10:20	10:21	10:30
	11:15	11:20	11:25	11:29	11:32	11:36	11:39	11:40	11:42	11:44	11:47	11:50	11:51	12:00
PM	12:45	12:50	12:55	12:59	1:02	1:06	1:09	1:10	1:12	1:14	1:17	1:20	1:21	1:30
	2:15	2:20	2:25	2:29	2:32	2:36	2:39	2:40	2:42	2:44	2:47	2:50	2:51	3:00
	3:45	3:50	3:55	3:59	4:02	4:06	4:09	4:10	4:12	4:14	4:17	4:20	4:21	4:30
	5:15	5:20	5:25	5:29	5:32	5:36	5:39	5:40	5:42	5:44	5:47	5:50	5:51	6:00
	6:15	6:20	6:25	6:29	6:32	6:36	6:39	6:40	6:42	6:44	6:47	6:50	6:51	7:00
	7:15	7:20	7:25	7:29	7:32	7:36	7:39	7:40	7:42	7:44	7:47	7:50	7:51	8:00

^ Services UPS Waiting Area

Weekday Schedule — Inbound

	14 IBM	13 Residence Inn	12 Westford Regency Hotel	11 Westford Valley Market Place	10 Hampton Inn Technology Drive	9 Nashoba Tech	8 Kidder Road	7 Littleton Rd & Hunt Rd	6 Chelmsford Center	5 Harvard Pilgrim Vanguard	4 Alpha Rd	3 UPS	2 Carlisle St. & Gorham	1 Kennedy Center Gallagher
AM	6:00	6:02	6:03	6:06	6:08	6:10	6:13	6:14	6:16	6:24	6:26	6:31	6:36	6:45
	7:30	7:32	7:33	7:36	7:38	7:40	7:43	7:44	7:46	7:54	7:56	8:01	8:06	8:15
	9:00	9:02	9:03	9:06	9:08	9:10	9:13	9:14	9:16	9:24	9:26	9:31	9:36	9:45
	10:30	10:32	10:33	10:36	10:38	10:40	10:43	10:44	10:46	10:54	10:56	11:01	11:06	11:15
PM	12:00	12:02	12:03	12:06	12:08	12:10	12:13	12:14	12:16	12:24	12:26	12:31	12:36	12:45
	1:30	1:32	1:33	1:36	1:38	1:40	1:43	1:44	1:46	1:54	1:56	2:01	2:06	2:15
	3:00	3:02	3:03	3:06	3:08	3:10	3:13	3:14	3:16	3:24	3:26	3:31	3:36	3:45
	4:30	4:32	4:33	4:36	4:38	4:40	4:43	4:44	4:46	4:54	4:56	5:01	5:06	5:15
	6:00	6:02	6:03	6:06	6:08	6:10	6:13	6:14	6:16	6:24	6:26	6:31	6:36	6:45
	7:00	7:02	7:03	7:06	7:08	7:10	7:13	7:14	7:16	7:24	7:26	7:31	7:36	7:45
	8:00	8:02	8:03	8:06	8:08	8:10	8:13	8:14	8:16	8:24	8:26	8:31	8:36	8:45

^ Services UPS Waiting Area

Saturday Schedule — Outbound

	1 Kennedy Center Gallagher	2 Carlisle St & Gorham St	3 UPS	4 Alpha Rd	5 Harvard Pilgrim Vanguard	6 Chelmsford Center	7 Littleton Rd & Hunt Rd	8 Kidder Road	9 Nashoba Tech	10 Hampton Inn Technology Drive	11 Westford Valley Market Place	12 Westford Regency Hotel	13 Residence Inn	14 IBM
AM	8:00	8:05	8:10	8:14	8:17	8:21	8:24	8:25	8:27	8:29	8:32	8:35	8:36	8:45
	9:30	9:35	9:40	9:44	9:47	9:51	9:54	9:55	9:57	9:59	10:02	10:05	10:06	10:15
	11:00	11:05	11:10	11:14	11:17	11:21	11:24	11:25	11:27	11:29	11:32	11:35	11:36	11:45
PM	12:30	12:35	12:40	12:44	1:02	1:06	1:09	1:10	1:12	1:14	1:17	1:20	1:21	1:30
	2:00	2:05	2:10	2:14	2:17	2:21	2:24	2:25	2:27	2:29	2:32	2:35	2:36	2:45
	3:30	3:35	3:40	3:44	3:47	3:51	3:54	3:55	3:57	3:59	4:02	4:05	4:06	4:15
	5:00	5:05	5:10	5:14	5:17	5:21	5:24	5:25	5:27	5:29	5:32	5:35	5:36	5:45

Saturday Schedule — Inbound

	14 IBM	13 Residence Inn	12 Westford Regency Hotel	11 Westford Valley Market Place	10 Hampton Inn Technology Drive	9 Nashoba Tech	8 Kidder Road	7 Littleton Rd & Hunt Rd	6 Chelmsford Center	5 Harvard Pilgrim Vanguard	4 Alpha Rd	3 UPS	2 Carlisle St. & Gorham	1 Kennedy Center Gallagher
AM	8:45	8:47	8:48	8:51	8:53	8:55	8:58	8:59	9:01	9:09	9:11	9:16	9:21	9:30
	10:15	10:17	10:18	10:21	10:23	10:25	10:28	10:29	10:31	10:39	10:41	10:46	10:51	11:00
	11:45	11:47	11:48	11:51	11:53	11:55	11:58	11:59	12:01	12:09	12:11	12:16	12:21	12:30
PM	1:15	1:17	1:18	1:21	1:23	1:25	1:28	1:29	1:31	1:39	1:41	1:46	1:51	2:00
	2:45	2:47	2:48	2:51	2:53	2:55	2:58	2:59	3:01	3:09	3:11	3:16	3:21	3:30
	4:15	4:17	4:18	4:21	4:23	4:25	4:28	4:29	4:31	4:39	4:41	4:46	4:51	5:00
	5:45	5:47	5:48	5:51	5:53	5:55	5:58	5:59	6:01	6:09	6:11	6:16	6:21	6:30

17 North Chelmsford Via Middlesex

Please visit www.lrta.com or call (978) 452-6161 for more information

Weekday Schedule

Outbound

	1 Kennedy Center Gallagher	2 Boy's Club	3 Pawtucket & Middlesex	4 Middlesex St Middlesex Plaza	5 Princeton Blvd Middlesex Plaza	6 Walmart & Drum Hill	7 LGH & Technology Dr	8 Princeton St & Brouillette St	9 Vinal Square	10 Chelmsford Senior Center	11 Triangle Store
AM	6:20	6:25	6:30	6:33	6:37	6:42	6:45	6:48	6:51	6:53	6:55
	7:25	7:30	7:35	7:38	7:42	7:47	7:50	7:53	7:56	7:58	8:00
	8:25	8:30	8:35	8:38	8:42	8:47	8:50	8:53	8:56	8:58	9:00
	9:25	9:30	9:35	9:38	9:42	9:47	9:50	9:53	9:56	9:58	10:00
	10:25	10:30	10:35	10:38	10:42	10:47	10:50	10:53	10:56	10:58	11:00
	11:25	11:30	11:35	11:38	11:42	11:47	11:50	11:53	11:56	11:58	12:00
PM	12:25	12:30	12:35	12:38	12:42	12:47	12:50	12:53	12:56	12:58	1:00
	1:25	1:30	1:35	1:38	1:42	1:47	1:50	1:53	1:56	1:58	2:00
	2:25	2:30	2:35	2:38	2:42	2:47	2:50	2:53	2:56	2:58	3:00
**	2:40	2:45	2:50	2:53	2:57	3:02	-----	-----	-----	-----	-----
	3:30	3:35	3:40	3:43	3:47	3:52	3:55	3:58	4:01	4:03	4:05
	4:00	4:05	4:10	4:13	4:17	4:22	4:25	4:28	4:31	4:33	4:35
	4:30	4:35	4:40	4:43	4:47	4:52	4:55	4:58	5:01	5:03	5:05
	5:30	5:35	5:40	5:43	5:47	5:52	5:55	5:58	6:01	6:03	6:05
	6:35	6:40	6:45	6:48	6:52	6:57	7:00	7:03	7:06	7:08	7:10

** *School days only:* *Departs from Paige & Kirk Street*

Weekday Schedule

Inbound

	11 Triangle Store	10 Chelmsford Senior Center	10 - I Mission Rd & Rte 3A	9 Vinal Square	8 Princeton St & Brouillette St	7 LGH & Technology Dr	6 Walmart & Drum Hill	5 Middlesex St Middlesex Plaza	4 Princeton Blvd Middlesex Plaza	3 Ideal Tape & Middlesex St	2 Boy's Club	1 Kennedy Center Gallagher
AM	6:00	6:02	6:06	6:10	6:16	6:17	6:18	6:22	6:24	6:27	6:32	6:36
*	-----	-----	-----	-----	-----	-----	7:15	7:19	7:21	7:24	7:29	7:33
	7:00	7:02	7:06	7:10	7:16	7:17	7:18	7:22	7:24	7:27	7:32	7:36
	8:00	8:02	8:06	8:10	8:16	8:17	8:18	8:22	8:24	8:27	8:32	8:36
	9:00	9:02	9:06	9:10	9:16	9:17	9:20	9:24	9:26	9:29	9:34	9:38
	10:00	10:02	10:06	10:10	10:16	10:17	10:18	10:22	10:24	10:27	10:32	10:36
	11:00	11:02	11:06	11:10	11:16	11:17	11:18	11:22	11:24	11:27	11:32	11:36
PM	12:00	12:02	12:06	12:10	12:16	12:17	12:18	12:22	12:24	12:27	12:32	12:36
	1:00	1:02	1:06	1:10	1:16	1:17	1:18	1:22	1:24	1:27	1:32	1:36
	2:00	2:02	2:06	2:10	2:16	2:17	2:18	2:22	2:24	2:27	2:32	2:36
	3:00	3:02	3:06	3:10	3:16	3:17	3:18	3:22	3:24	3:27	3:32	3:36
	4:05	4:07	4:11	4:15	4:21	4:22	4:23	4:27	4:29	4:32	4:37	4:41
	4:35	4:37	4:41	4:45	4:51	4:52	4:53	4:57	4:59	5:02	5:07	5:11
	5:05	5:07	5:11	5:15	5:21	5:22	5:23	5:27	5:29	5:32	5:37	5:41
	6:10	6:12	6:16	6:20	6:26	6:27	6:28	6:32	6:34	6:37	6:42	6:46
	7:10	7:12	7:16	7:20	7:26	7:27	7:28	7:32	7:34	7:37	7:42	7:46

* School days only:

Saturday Schedule

Outbound

	Kennedy Center Departure	Boy's Club	Pawtucket & Middlesex	Middlesex st Middlesex Plaza	Princeton Blvd Middlesex Plaza	Walmart Drum Hill	LGH & Technology Dr	Princeton St & Brouillette st	Vinal Square	Chelmsford Senior Center	Triangle Store
AM	8:00	8:06	8:12	8:15	8:21	8:27	8:30	8:35	8:38	8:43	8:45
	9:00	9:06	9:12	9:15	9:21	9:27	9:30	9:35	9:38	9:43	9:45
	10:00	10:06	10:12	10:15	10:21	10:27	10:30	10:35	10:38	10:43	10:45
	11:00	11:06	11:12	11:15	11:21	11:27	11:30	11:35	11:38	11:43	11:45
PM	12:00	12:06	12:12	12:15	12:21	12:27	12:30	12:35	12:38	12:43	12:45
	1:00	1:06	1:12	1:15	1:21	1:27	1:30	1:35	1:38	1:43	1:45
	2:00	2:06	2:12	2:15	2:21	2:27	2:30	2:35	2:38	2:43	2:45
	3:00	3:06	3:12	3:15	3:21	3:27	3:30	3:35	3:38	3:43	3:45
	4:00	4:06	4:12	4:15	4:21	4:27	4:30	4:35	4:38	4:43	4:45
	5:00	5:06	5:12	5:15	5:21	5:27	5:30	5:35	5:38	5:43	5:45

Saturday Schedule

Inbound

	Triangle Store	Chelmsford Senior Center	Mission Rd. & Rte 3A	Vinal Square	Princeton St. & Brouillette St.	LGH & Technology dr	Walmart & Drum Hill	Middlesex st Middlesex Plaza	Princeton blvd Middlesex Plaza	Ideal Tape & Middlesex st	Boy's Club	Kennedy Center Arrival
AM	7:55	7:57	8:01	8:08	8:14	8:15	8:19	8:23	8:25	8:31	8:36	8:40
	8:55	8:57	9:01	9:08	9:14	9:15	9:19	9:23	9:25	9:31	9:36	9:40
	9:55	9:57	10:01	10:08	10:14	10:15	10:19	10:23	10:25	10:31	10:36	10:40
	10:55	10:57	11:01	11:08	11:14	11:15	11:19	11:23	11:25	11:31	11:36	11:40
	11:55	11:57	12:01	12:08	12:14	12:15	12:19	12:23	12:25	12:31	12:36	12:40
PM	12:55	12:57	13:01	1:08	1:14	1:15	1:19	1:23	1:25	1:31	1:36	1:40
	1:55	1:57	2:01	2:08	2:14	2:15	2:19	2:23	2:25	2:31	2:36	2:40
	2:55	2:57	3:01	3:08	3:14	3:15	3:19	3:23	3:25	3:31	3:36	3:40
	3:55	3:57	4:01	4:08	4:14	4:15	4:19	4:23	4:25	4:31	4:36	4:40
	4:55	4:57	5:01	5:08	5:14	5:15	5:19	5:23	5:25	5:31	5:36	5:40
	5:55	5:57	6:01	6:08	6:14	6:15	6:19	6:23	6:25	6:31	6:36	6:40

QUICK LINKS

Schedules & Maps ▶

Fare Info ▶

Paratransit ▶

Parking ▶

Service Alerts ▶

CharlieCard ▶

Public Information ▶

Regional Connections ▶

TRIP PLANNER

Start (e.g. Belvidere)

End (e.g. Centralville)

Get Started ▶

Fare Information

Fixed Route | Paratransit (Roadrunner) | Parking

Fixed Route Bus Service

Cash Fares

City/ Local/ Shuttle- Regular	$1.00
City/ Local/ Shuttle- Reduced	$0.50
Suburban – Regular	$1.50
Suburban- Reduced	$.75

Transfers

Free transfers are available to and from the Downtown Shuttle.

In-Town- Regular	$0.25
In-Town- Reduced	$0.10
Suburban – Regular	$0.50
Suburban- Reduced	$0.25

CharlieCard Monthly Passes

Adult Pass	$35.00
Senior Pass	$20.00
Student Pass	$20.00
Persons with Disabilities Pass	$20.00

(for persons with Disabilities/TAP CharlieCard)

LRTA Monthly Passes can be purchased at the following locations:

(Please note that we only accept cash, check or money order).

LRTA Transit Center- Kennedy Center 145 Thorndike St., Lowell, MA 01852

– Passes can be purchased at the Bus Information Booth outside, or inside at our Ticket Vending Machine (TVM).

Lowell High School – Kirk St. Lowell, MA. 01852 (sold on the last day & first day of each month in both cafeterias to LHS students).

Passes may also be purchased by sending a check or money order to:

Lowell Transportation Management, Inc.
Attn.: Monthly Bus Passes
100 Hale St. Lowell, MA. 01851
Telephone: (978) 452-6161 ext. 202

Translate

Fare Categories

Regular

- Persons from 13 to 59 years of age.

Reduced

-60 years or older with I.D.

-With Statewide Transportation Access Pass or Medicare Card.

Children

– From 6 to 12 years of age.

– Children 5 and under ride free and must be accompanied by an adult.

Paratransit (Roadrunner)

In-town	$1.00
Travel between Communities	$1.50
Boston (Wednesdays)	$25.00
Bedford VA (Wednesdays)	$12.50

For Paratransit questions, please call (978) 459-0152

Parking

Gallagher Intermodal Parking Garage (Thorndike St., Lowell)

Daily	$5.00
Overnight	$10.00
Monthly	$50.00

Parking at North Billerica Train Station

Daily	$4.00
Billerica Residents	$2.00
Monthly (Billerica Residents)	$40.00
Monthly (Non-Residents)	$70.00

Contact ▶ eNewsletter ▶ Recent News ▶

VEHICLE TRAVEL SPEED DATA

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA
EB

6951SPD2

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	Pace Speed	Number in Pace
02/05/15	0	0	2	10	6	4	0	0	0	0	0	0	0	0	22	26-35	16
01:00	0	0	0	1	1	1	0	0	0	0	0	0	0	0	3	24-33	2
02:00	0	0	1	3	4	0	0	0	0	0	0	0	0	0	8	26-35	7
03:00	0	0	1	2	6	3	0	0	0	0	0	0	0	0	12	29-38	9
04:00	0	1	7	7	25	11	5	0	0	0	0	0	0	0	56	31-40	36
05:00	0	0	0	30	144	69	7	0	0	0	0	0	0	0	250	31-40	213
06:00	3	2	12	72	175	96	8	0	0	0	0	0	0	0	368	31-40	271
07:00	**14**	0	3	71	**235**	**151**	18	0	0	0	0	0	0	0	492	31-40	386
08:00	4	**4**	**45**	**140**	208	91	5	0	0	0	0	0	0	0	**497**	26-35	348
09:00	4	4	9	56	192	151	30	1	**1**	0	0	0	0	0	448	31-40	343
10:00	1	2	8	10	84	150	42	1	0	0	0	0	0	0	298	31-40	234
11:00	0	2	8	13	58	130	**57**	**3**	0	0	0	0	0	0	271	31-40	188
12 PM	0	**1**	3	12	56	135	61	3	0	0	0	**1**	0	0	272	36-45	196
13:00	2	1	2	8	57	118	57	**9**	0	0	0	0	0	0	254	31-40	175
14:00	0	0	**10**	11	93	148	45	7	0	0	0	0	0	0	314	31-40	241
15:00	**5**	0	0	8	66	187	57	3	0	0	0	0	0	0	326	31-40	253
16:00	4	0	1	14	96	**188**	**63**	6	0	0	0	0	0	0	372	31-40	284
17:00	0	1	2	30	153	185	42	1	**1**	0	0	0	0	0	**415**	31-40	338
18:00	0	0	7	**66**	**183**	95	14	0	0	0	0	0	0	0	365	31-40	278
19:00	0	0	2	26	108	89	17	1	0	0	0	0	0	0	243	31-40	197
20:00	0	0	0	5	48	43	22	1	0	0	0	0	0	0	119	31-40	91
21:00	0	0	0	11	38	51	7	1	0	0	0	0	0	0	108	31-40	89
22:00	0	0	0	5	24	30	11	2	0	0	0	0	0	0	72	31-40	54
23:00	0	0	0	3	7	16	6	3	1	0	0	0	0	0	36	31-40	23
Total	37	18	123	614	2067	2142	574	42	3	0	0	1	0	0	5621		
Percent	0.7%	0.3%	2.2%	10.9%	36.8%	38.1%	10.2%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	08:00	08:00	08:00	07:00	07:00	11:00	11:00	09:00						08:00		
Vol.	14	4	45	140	235	151	57	3	1						497		
PM Peak	15:00	12:00	14:00	18:00	18:00	16:00	16:00	13:00	17:00			12:00			17:00		
Vol.	5	1	10	66	183	188	63	9	1			1			415		

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA
EB

6951SPD2

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	Pace Speed	Number in Pace
02/06/15	0	0	0	0	5	6	0	0	0	0	0	0	0	0	11	31-40	11
01:00	2	0	0	1	0	0	1	0	0	0	0	0	0	0	4	8-17	1
02:00	0	0	0	2	1	2	2	0	0	0	0	0	0	0	7	34-43	4
03:00	0	0	0	0	4	4	5	1	0	0	0	0	0	0	14	34-43	9
04:00	0	0	0	0	11	31	15	2	0	0	0	0	0	0	59	36-45	46
05:00	0	0	0	2	45	136	34	2	0	0	0	0	0	0	219	31-40	181
06:00	2	0	1	9	89	232	51	8	0	0	0	0	0	0	392	31-40	321
07:00	1	0	1	17	125	306	**135**	**11**	**2**	0	0	0	0	0	598	36-45	441
08:00	**10**	**9**	**12**	20	**175**	**356**	96	8	0	0	0	0	0	0	**686**	31-40	531
09:00	2	1	3	**22**	112	261	109	10	0	0	0	0	0	0	520	31-40	373
10:00	2	2	8	9	71	211	84	11	0	0	0	0	0	0	398	36-45	295
11:00	3	3	12	3	55	188	100	8	0	0	0	0	0	0	372	36-45	288
12 PM	0	0	7	6	70	151	**113**	12	0	0	0	0	0	0	359	36-45	264
13:00	1	0	**11**	18	55	151	71	8	1	0	0	0	0	0	316	36-45	222
14:00	2	0	3	13	112	176	69	9	0	0	0	0	0	0	384	31-40	288
15:00	5	0	4	18	103	207	97	8	0	0	0	0	0	0	442	31-40	310
16:00	**13**	0	0	10	91	247	99	**14**	**2**	0	0	0	0	0	476	36-45	346
17:00	6	0	0	18	144	**276**	79	6	0	0	0	0	0	0	529	31-40	420
18:00	4	0	2	**31**	**238**	246	37	3	0	0	0	0	0	0	**561**	31-40	484
19:00	0	0	3	13	151	150	38	4	0	0	0	0	0	0	359	31-40	301
20:00	2	0	0	12	56	91	27	4	0	0	0	0	0	0	192	31-40	147
21:00	2	0	0	11	33	54	24	0	1	0	0	0	0	0	125	31-40	87
22:00	1	0	0	5	21	58	30	3	1	0	0	0	0	0	119	36-45	88
23:00	0	0	0	4	17	22	29	4	0	0	0	0	0	0	76	36-45	51
Total	58	15	67	244	1784	3562	1345	136	7	0	0	0	0	0	7218		
Percent	0.8%	0.2%	0.9%	3.4%	24.7%	49.3%	18.6%	1.9%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	08:00	08:00	09:00	08:00	08:00	07:00	07:00	07:00						08:00		
Vol.	10	9	12	22	175	356	135	11	2						686		
PM Peak	16:00		13:00	18:00	18:00	17:00	12:00	16:00	16:00						18:00		
Vol.	13		11	31	238	276	113	14	2						561		

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA
EB

6951SPD2

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	Pace Speed	Number in Pace
02/07/15	0	0	0	1	5	15	6	0	0	0	0	0	0	0	27	36-45	21
01:00	0	0	0	0	4	7	4	0	0	0	0	0	0	0	15	36-45	11
02:00	0	0	1	5	3	4	1	0	0	0	0	0	0	0	14	25-34	8
03:00	0	0	0	0	0	3	1	0	0	0	0	0	0	0	4	34-43	4
04:00	0	0	0	1	1	9	12	1	1	0	0	0	0	0	25	36-45	21
05:00	0	0	0	0	9	25	7	2	0	0	0	0	0	0	43	31-40	34
06:00	0	0	0	0	7	48	43	11	0	0	0	0	0	0	109	36-45	91
07:00	0	0	0	0	38	100	96	14	0	0	0	0	0	0	248	36-45	196
08:00	1	0	0	1	25	146	123	15	1	0	0	0	0	0	312	36-45	269
09:00	2	0	0	3	72	204	135	14	1	0	0	0	0	0	431	36-45	339
10:00	3	0	0	2	87	274	142	26	0	0	0	0	0	0	534	36-45	416
11:00	3	0	0	0	74	273	164	18	2	0	0	0	0	0	534	36-45	437
12 PM	5	0	0	2	48	257	169	17	2	0	0	0	0	0	500	36-45	426
13:00	4	0	0	3	71	214	133	18	2	0	0	0	0	0	445	36-45	347
14:00	0	0	0	3	38	230	118	11	2	1	0	0	0	0	403	36-45	348
15:00	2	1	0	10	51	186	124	20	2	0	0	0	0	0	396	36-45	310
16:00	2	0	0	4	48	194	94	11	0	0	0	0	0	0	353	36-45	288
17:00	0	0	0	6	112	172	75	6	0	0	0	0	0	0	371	31-40	284
18:00	2	0	0	14	114	163	34	1	0	0	0	0	0	0	328	31-40	277
19:00	1	0	0	5	76	121	24	1	0	0	0	0	0	0	228	31-40	197
20:00	1	0	0	11	36	61	32	3	1	0	0	0	0	0	145	31-40	97
21:00	0	0	0	4	28	58	16	1	1	0	0	0	0	0	108	31-40	86
22:00	2	0	0	14	38	48	10	1	0	0	0	0	0	0	113	31-40	86
23:00	0	0	7	20	38	18	3	0	0	0	0	0	0	0	86	26-35	58
Total	28	1	8	109	1023	2830	1566	191	15	1	0	0	0	0	5772		
Percent	0.5%	0.0%	0.1%	1.9%	17.7%	49.0%	27.1%	3.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	10:00		02:00	02:00	10:00	10:00	11:00	10:00	11:00						10:00		
Vol.	3		1	5	87	274	164	26	2						534		
PM Peak	12:00	15:00	23:00	23:00	18:00	12:00	12:00	15:00	12:00	14:00					12:00		
Vol.	5	1	7	20	114	257	169	20	2	1					500		
Total	123	34	198	967	4874	8534	3485	369	25	1	0	1	0	0	18611		
Percent	0.7%	0.2%	1.1%	5.2%	26.2%	45.9%	18.7%	2.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%			

15th Percentile : 31 MPH
50th Percentile : 36 MPH
85th Percentile : 41 MPH
95th Percentile : 44 MPH

Stats

10 MPH Pace Speed : 31-40 MPH
Number in Pace : 13408
Percent in Pace : 72.0%
Number of Vehicles > 35 MPH : 12415
Percent of Vehicles > 35 MPH : 66.7%
Mean Speed(Average) : 37 MPH

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA
WB

6951SPD2

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	Pace Speed	Number in Pace
02/05/15	0	1	1	5	9	11	2	0	0	0	0	0	0	0	29	31-40	20
01:00	0	0	2	3	7	0	1	0	0	0	0	0	0	0	13	26-35	10
02:00	0	0	1	4	3	2	0	0	0	0	0	0	0	0	10	26-35	7
03:00	0	0	1	2	3	0	0	0	0	0	0	0	0	0	6	25-34	5
04:00	0	0	1	6	9	2	1	0	0	0	0	0	0	0	19	26-35	15
05:00	0	0	1	18	40	9	3	0	0	0	0	0	0	0	71	26-35	58
06:00	2	1	4	37	72	27	4	1	0	0	0	0	0	0	148	26-35	109
07:00	2	0	7	11	**93**	**112**	23	1	0	0	0	0	0	0	249	31-40	205
08:00	**9**	**38**	**40**	**53**	89	36	5	0	0	0	0	0	0	0	**270**	26-35	142
09:00	0	4	7	33	83	78	20	0	0	0	0	0	0	0	225	31-40	161
10:00	1	2	9	10	47	83	29	4	0	0	0	0	0	0	185	31-40	130
11:00	3	11	14	12	36	96	**30**	**6**	1	0	0	0	0	0	209	31-40	132
12 PM	0	6	4	8	32	83	64	9	0	0	0	0	0	0	206	36-45	147
13:00	1	**9**	10	19	48	119	58	15	0	0	0	0	0	0	279	36-45	177
14:00	1	2	**15**	10	49	136	100	**20**	0	0	0	0	0	0	333	36-45	236
15:00	**6**	1	1	7	74	236	104	10	**1**	0	0	0	0	0	440	36-45	340
16:00	2	0	4	14	98	249	100	5	1	0	0	0	0	0	473	35-44	349
17:00	0	0	0	34	139	**289**	**118**	8	1	0	0	0	0	0	**589**	31-40	428
18:00	2	0	3	**52**	**239**	207	35	0	0	0	0	0	0	0	538	31-40	446
19:00	0	0	0	30	202	187	40	1	0	0	0	0	0	0	460	31-40	389
20:00	0	0	0	7	82	164	48	3	0	0	0	0	0	0	304	31-40	246
21:00	0	0	0	5	51	112	55	2	0	0	0	0	0	0	225	36-45	167
22:00	0	0	0	7	41	87	36	1	0	0	0	0	0	0	172	31-40	128
23:00	0	0	0	0	12	31	17	5	0	0	0	0	0	0	65	36-45	48
Total	29	75	125	387	1558	2356	893	91	4	0	0	0	0	0	5518		
Percent	0.5%	1.4%	2.3%	7.0%	28.2%	42.7%	16.2%	1.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	08:00	08:00	08:00	07:00	07:00	11:00	11:00	11:00						08:00		
Vol.	9	38	40	53	93	112	30	6	1						270		
PM Peak	15:00	13:00	14:00	18:00	18:00	17:00	17:00	14:00	15:00						17:00		
Vol.	6	9	15	52	239	289	118	20	1						589		

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA
WB

6951SPD2

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	Pace Speed	Number in Pace
02/06/15	0	0	0	2	4	21	11	3	2	0	0	0	0	0	43	36-45	32
01:00	0	0	0	1	1	11	2	2	0	0	0	0	0	0	17	36-45	13
02:00	0	0	0	0	3	5	2	0	0	0	0	0	0	0	10	31-40	8
03:00	0	0	0	0	4	8	3	0	0	0	0	0	0	0	15	31-40	12
04:00	0	0	1	3	5	14	8	0	0	0	0	0	0	0	31	36-45	22
05:00	0	0	0	1	19	24	11	1	0	0	0	0	0	0	56	31-40	43
06:00	0	0	0	5	44	100	38	2	0	0	0	0	0	0	189	31-40	144
07:00	1	0	4	5	25	146	**102**	**13**	1	0	0	0	0	0	297	36-45	248
08:00	**5**	**7**	**16**	**18**	**54**	**153**	63	7	1	0	0	0	0	0	**324**	36-45	216
09:00	2	0	2	8	41	102	70	10	**3**	0	0	0	0	0	238	36-45	172
10:00	4	2	7	7	33	102	64	11	1	0	0	0	0	0	231	36-45	166
11:00	4	6	15	12	43	101	84	12	1	0	0	0	0	0	278	36-45	185
12 PM	0	2	6	13	45	130	94	15	**3**	0	0	0	0	0	308	36-45	224
13:00	1	4	**16**	11	50	155	118	14	1	0	0	0	0	0	370	36-45	273
14:00	0	1	5	5	67	201	**142**	**16**	2	0	0	0	0	0	439	36-45	343
15:00	**6**	**11**	13	9	84	**263**	122	16	0	0	0	0	0	0	**524**	36-45	385
16:00	5	1	0	3	65	233	139	15	1	0	0	0	0	0	462	36-45	372
17:00	2	0	1	11	99	226	126	15	0	0	0	0	0	0	480	36-45	352
18:00	2	0	2	**27**	**218**	218	31	3	0	0	0	0	0	0	501	31-40	436
19:00	0	0	0	24	185	183	37	1	0	0	0	0	0	0	430	31-40	368
20:00	1	1	2	5	121	166	43	3	0	0	0	0	0	0	342	31-40	287
21:00	0	0	0	8	79	165	36	2	0	0	0	0	0	0	290	31-40	244
22:00	1	0	0	4	59	166	62	7	2	0	0	0	0	0	301	36-45	228
23:00	0	0	0	0	11	63	35	1	0	0	0	0	0	0	110	36-45	98
Total	34	35	90	182	1359	2956	1443	169	18	0	0	0	0	0	6286		
Percent	0.5%	0.6%	1.4%	2.9%	21.6%	47.0%	23.0%	2.7%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	07:00	07:00	09:00						08:00		
Vol.	5	7	16	18	54	153	102	13	3						324		
PM Peak	15:00	15:00	13:00	18:00	18:00	15:00	14:00	14:00	12:00						15:00		
Vol.	6	11	16	27	218	263	142	16	3						524		

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA
WB

6951SPD2

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	Pace Speed	Number in Pace
02/07/15	0	0	0	1	15	28	11	3	0	0	0	0	0	0	58	31-40	43
01:00	0	0	0	0	4	17	11	3	0	0	0	0	0	0	35	36-45	28
02:00	1	0	0	1	4	7	7	0	0	0	0	0	0	0	20	36-45	14
03:00	0	0	0	0	5	8	0	0	0	0	0	0	0	0	13	31-40	13
04:00	0	0	0	1	7	8	3	1	0	0	0	0	0	0	20	31-40	15
05:00	0	0	0	1	5	16	10	0	0	0	0	0	0	0	32	36-45	26
06:00	0	0	0	1	4	26	30	3	0	0	0	0	0	0	64	36-45	56
07:00	0	0	0	2	6	37	34	13	2	0	0	0	0	0	94	36-45	71
08:00	1	0	0	2	17	51	77	**24**	1	0	0	0	0	0	173	36-45	128
09:00	**2**	0	0	3	**25**	94	102	17	**6**	**1**	0	0	0	0	250	36-45	196
10:00	1	0	0	**4**	17	145	107	20	3	0	0	0	0	0	297	36-45	252
11:00	1	**4**	**1**	1	23	**197**	**172**	21	2	0	0	0	0	0	**422**	36-45	369
12 PM	1	0	0	1	36	165	161	32	**4**	0	0	0	0	0	400	36-45	326
13:00	2	0	1	1	22	200	203	**33**	1	0	0	0	0	0	463	36-45	403
14:00	0	0	0	0	33	**217**	**206**	22	0	0	0	0	0	0	478	36-45	423
15:00	0	0	1	4	43	208	202	27	2	0	0	0	0	0	**487**	36-45	410
16:00	**4**	0	0	2	41	180	179	19	2	0	0	0	0	0	427	36-45	359
17:00	0	0	0	2	72	212	115	8	1	0	0	0	0	0	410	36-45	327
18:00	0	0	0	3	**96**	186	47	3	0	0	0	0	0	0	335	31-40	282
19:00	1	0	0	6	61	137	46	5	1	0	0	0	0	0	257	31-40	198
20:00	1	0	0	6	52	130	41	2	2	0	0	0	0	0	234	31-40	182
21:00	0	0	0	2	38	116	30	5	1	0	0	0	0	0	192	31-40	154
22:00	0	0	0	5	58	75	22	4	0	**1**	0	0	0	0	165	31-40	133
23:00	0	0	7	**41**	61	34	1	0	0	0	0	0	0	0	144	26-35	102
Total	15	4	10	90	745	2494	1817	265	28	2	0	0	0	0	5470		
Percent	0.3%	0.1%	0.2%	1.6%	13.6%	45.6%	33.2%	4.8%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	09:00	11:00	11:00	10:00	09:00	11:00	11:00	08:00	09:00	09:00					11:00		
Vol.	2	4	1	4	25	197	172	24	6	1					422		
PM Peak	16:00		23:00	23:00	18:00	14:00	14:00	13:00	12:00	22:00					15:00		
Vol.	4		7	41	96	217	206	33	4	1					487		
Total	78	114	225	659	3662	7806	4153	525	50	2	0	0	0	0	17274		
Percent	0.5%	0.7%	1.3%	3.8%	21.2%	45.2%	24.0%	3.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%			

15th Percentile :	32 MPH
50th Percentile :	37 MPH
85th Percentile :	42 MPH
95th Percentile :	44 MPH

Stats

10 MPH Pace Speed :	36-45 MPH
Number in Pace :	11959
Percent in Pace :	69.2%
Number of Vehicles > 35 MPH :	12536
Percent of Vehicles > 35 MPH :	72.6%
Mean Speed(Average) :	38 MPH

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA
EB, WB

6951SPD2

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	Pace Speed	Number in Pace
02/05/15	0	1	3	15	15	15	2	0	0	0	0	0	0	0	51	26-35	30
01:00	0	0	2	4	8	1	1	0	0	0	0	0	0	0	16	26-35	12
02:00	0	0	2	7	7	2	0	0	0	0	0	0	0	0	18	26-35	14
03:00	0	0	2	4	9	3	0	0	0	0	0	0	0	0	18	26-35	13
04:00	0	1	8	13	34	13	6	0	0	0	0	0	0	0	75	31-40	47
05:00	0	0	1	48	184	78	10	0	0	0	0	0	0	0	321	31-40	262
06:00	5	3	16	109	247	123	12	1	0	0	0	0	0	0	516	31-40	370
07:00	**16**	0	10	82	**328**	**263**	41	1	0	0	0	0	0	0	741	31-40	591
08:00	13	**42**	**85**	**193**	297	127	10	0	0	0	0	0	0	0	**767**	26-35	490
09:00	4	8	16	89	275	229	50	1	**1**	0	0	0	0	0	673	31-40	504
10:00	2	4	17	20	131	233	71	5	0	0	0	0	0	0	483	31-40	364
11:00	3	13	22	25	94	226	**87**	**9**	1	0	0	0	0	0	480	31-40	320
12 PM	0	7	7	20	88	218	125	12	0	0	0	**1**	0	0	478	36-45	343
13:00	3	**10**	12	27	105	237	115	24	0	0	0	0	0	0	533	36-45	352
14:00	1	2	**25**	21	142	284	145	**27**	0	0	0	0	0	0	647	36-45	429
15:00	**11**	1	1	15	140	423	161	13	1	0	0	0	0	0	766	36-45	584
16:00	6	0	5	28	194	437	**163**	11	1	0	0	0	0	0	845	31-40	631
17:00	0	1	2	64	292	**474**	160	9	**2**	0	0	0	0	0	**1004**	31-40	766
18:00	2	0	10	**118**	**422**	302	49	0	0	0	0	0	0	0	903	31-40	724
19:00	0	0	2	56	310	276	57	2	0	0	0	0	0	0	703	31-40	586
20:00	0	0	0	12	130	207	70	4	0	0	0	0	0	0	423	31-40	337
21:00	0	0	0	16	89	163	62	3	0	0	0	0	0	0	333	31-40	252
22:00	0	0	0	12	65	117	47	3	0	0	0	0	0	0	244	31-40	182
23:00	0	0	0	3	19	47	23	8	1	0	0	0	0	0	101	36-45	70
Total	66	93	248	1001	3625	4498	1467	133	7	0	0	1	0	0	11139		
Percent	0.6%	0.8%	2.2%	9.0%	32.5%	40.4%	13.2%	1.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	08:00	08:00	08:00	07:00	07:00	11:00	11:00	09:00						08:00		
Vol.	16	42	85	193	328	263	87	9	1						767		
PM Peak	15:00	13:00	14:00	18:00	18:00	17:00	16:00	14:00	17:00			12:00			17:00		
Vol.	11	10	25	118	422	474	163	27	2			1			1004		

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA
EB, WB

6951SPD2

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	Pace Speed	Number in Pace
02/06/15	0	0	0	2	9	27	11	3	2	0	0	0	0	0	54	35-44	38
01:00	2	0	0	2	1	11	3	2	0	0	0	0	0	0	21	36-45	14
02:00	0	0	0	2	4	7	4	0	0	0	0	0	0	0	17	36-45	11
03:00	0	0	0	0	8	12	8	1	0	0	0	0	0	0	29	31-40	20
04:00	0	0	1	3	16	45	23	2	0	0	0	0	0	0	90	36-45	68
05:00	0	0	0	3	64	160	45	3	0	0	0	0	0	0	275	31-40	224
06:00	2	0	1	14	133	332	89	10	0	0	0	0	0	0	581	31-40	465
07:00	2	0	5	22	150	452	**237**	**24**	**3**	0	0	0	0	0	895	36-45	689
08:00	**15**	**16**	**28**	**38**	**229**	**509**	159	15	1	0	0	0	0	0	**1010**	31-40	738
09:00	4	1	5	30	153	363	179	20	3	0	0	0	0	0	758	36-45	542
10:00	6	4	15	16	104	313	148	22	1	0	0	0	0	0	629	36-45	461
11:00	7	9	27	15	98	289	184	20	1	0	0	0	0	0	650	36-45	473
12 PM	0	2	13	19	115	281	207	27	**3**	0	0	0	0	0	667	36-45	488
13:00	2	4	**27**	29	105	306	189	22	2	0	0	0	0	0	686	36-45	495
14:00	2	1	8	18	179	377	211	25	2	0	0	0	0	0	823	36-45	588
15:00	11	**11**	17	27	187	470	219	24	0	0	0	0	0	0	966	36-45	689
16:00	**18**	1	0	13	156	480	**238**	**29**	3	0	0	0	0	0	938	36-45	718
17:00	8	0	1	29	243	**502**	205	21	0	0	0	0	0	0	1009	31-40	745
18:00	6	0	4	**58**	**456**	464	68	6	0	0	0	0	0	0	**1062**	31-40	920
19:00	0	0	3	37	336	333	75	5	0	0	0	0	0	0	789	31-40	669
20:00	3	1	2	17	177	257	70	7	0	0	0	0	0	0	534	31-40	434
21:00	2	0	0	19	112	219	60	2	1	0	0	0	0	0	415	31-40	331
22:00	2	0	0	9	80	224	92	10	3	0	0	0	0	0	420	36-45	316
23:00	0	0	0	4	28	85	64	5	0	0	0	0	0	0	186	36-45	149
Total	92	50	157	426	3143	6518	2788	305	25	0	0	0	0	0	13504		
Percent	0.7%	0.4%	1.2%	3.2%	23.3%	48.3%	20.6%	2.3%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	07:00	07:00	07:00						08:00		
Vol.	15	16	28	38	229	509	237	24	3						1010		
PM Peak	16:00	15:00	13:00	18:00	18:00	17:00	16:00	16:00	12:00						18:00		
Vol.	18	11	27	58	456	502	238	29	3						1062		

Accurate Counts

978-664-2565

Location : Route 40
Location : East of Newport Materials Dwy
City/State: Westford, MA
EB, WB

6951SPD2

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	Pace Speed	Number in Pace
02/07/15	0	0	0	2	20	43	17	3	0	0	0	0	0	0	85	31-40	63
01:00	0	0	0	0	8	24	15	3	0	0	0	0	0	0	50	36-45	39
02:00	1	0	**1**	**6**	7	11	8	0	0	0	0	0	0	0	34	36-45	19
03:00	0	0	0	0	5	11	1	0	0	0	0	0	0	0	17	31-40	16
04:00	0	0	0	2	8	17	15	2	**1**	0	0	0	0	0	45	36-45	32
05:00	0	0	0	1	14	41	17	2	0	0	0	0	0	0	75	36-45	58
06:00	0	0	0	1	11	74	73	14	0	0	0	0	0	0	173	36-45	147
07:00	0	0	0	2	44	137	130	27	2	0	0	0	0	0	342	36-45	267
08:00	2	0	0	3	42	197	200	39	2	0	0	0	0	0	485	36-45	397
09:00	**4**	0	0	6	97	298	237	31	**7**	**1**	0	0	0	0	681	36-45	535
10:00	4	0	0	6	**104**	419	249	**46**	3	0	0	0	0	0	831	36-45	668
11:00	4	**4**	1	1	97	**470**	**336**	39	4	0	0	0	0	0	**956**	36-45	806
12 PM	**6**	0	0	3	84	422	330	49	**6**	0	0	0	0	0	900	36-45	752
13:00	6	0	1	4	93	414	**336**	**51**	3	0	0	0	0	0	**908**	36-45	750
14:00	0	0	0	3	71	**447**	324	33	2	**1**	0	0	0	0	881	36-45	771
15:00	2	**1**	1	14	94	394	326	47	4	0	0	0	0	0	883	36-45	720
16:00	6	0	0	6	89	374	273	30	2	0	0	0	0	0	780	36-45	647
17:00	0	0	0	8	184	384	190	14	1	0	0	0	0	0	781	36-45	574
18:00	2	0	0	17	**210**	349	81	4	0	0	0	0	0	0	663	31-40	559
19:00	2	0	0	11	137	258	70	6	1	0	0	0	0	0	485	31-40	395
20:00	2	0	0	17	88	191	73	5	3	0	0	0	0	0	379	31-40	279
21:00	0	0	0	6	66	174	46	6	2	0	0	0	0	0	300	31-40	240
22:00	2	0	0	19	96	123	32	5	0	1	0	0	0	0	278	31-40	219
23:00	0	0	**14**	**61**	99	52	4	0	0	0	0	0	0	0	230	26-35	160
Total	43	5	18	199	1768	5324	3383	456	43	3	0	0	0	0	11242		
Percent	0.4%	0.0%	0.2%	1.8%	15.7%	47.4%	30.1%	4.1%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	09:00	11:00	02:00	02:00	10:00	11:00	11:00	10:00	09:00	09:00					11:00		
Vol.	4	4	1	6	104	470	336	46	7	1					956		
PM Peak	12:00	15:00	23:00	23:00	18:00	14:00	13:00	13:00	12:00	14:00					13:00		
Vol.	6	1	14	61	210	447	336	51	6	1					908		
Total	201	148	423	1626	8536	16340	7638	894	75	3	0	1	0	0	35885		
Percent	0.6%	0.4%	1.2%	4.5%	23.8%	45.5%	21.3%	2.5%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%			

15th Percentile : 31 MPH
50th Percentile : 37 MPH
85th Percentile : 42 MPH
95th Percentile : 44 MPH

Stats

10 MPH Pace Speed : 31-40 MPH
Number in Pace : 24876
Percent in Pace : 69.3%
Number of Vehicles > 35 MPH : 24951
Percent of Vehicles > 35 MPH : 69.5%
Mean Speed(Average) : 37 MPH

MASSDOT CRASH RATE WORKSHEETS

MassDOT

CRASH RATE WORKSHEET

CITY/TOWN : Westford COUNT DATE : 2015

DISTRICT : 3 UNSIGNALIZED : Yes SIGNALIZED :

MHD USE ONLY

Source #

~ INTERSECTION DATA ~

MAJOR STREET : Groton Road (Route 40) ST #

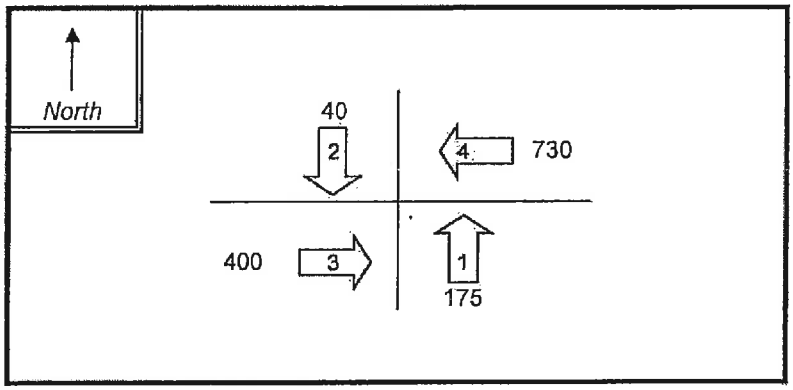
MINOR STREET(S) : Oak Hill Road ST #

ST #

ST #

ST #

INTERSECTION DIAGRAM (Label Approaches)



INTERSECTION REF:#

Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB	WB		
VOLUMES (AM/PM) :	175	40	400	730		1,345

" K " FACTOR : 0.090 APPROACH ADT : 14,944 ADT = TOTAL VOL/"K" FACT.

TOTAL # OF ACCIDENTS : 25 # OF YEARS : 5 AVERAGE # OF ACCIDENTS (A) : 5.00

CRASH RATE CALCULATION : 0.92 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

Comments : Crash rate is significant if > 0.58 crashes per mev for an unsignalized intersection for MassDOT District 3.

CRASH RATE WORKSHEET

CITY/TOWN : Westford COUNT DATE : 2015

DISTRICT : 3 UNSIGNALIZED : Yes SIGNALIZED :

MHD USE ONLY

Source #

~ INTERSECTION DATA ~

MAJOR STREET : Groton Road (Route 40) ST #

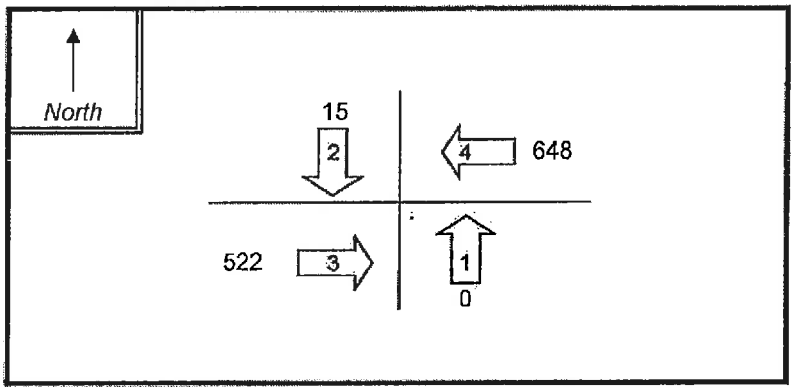
MINOR STREET(S) : Commerce Way (#540 Groton Road) ST #

ST #

ST #

ST #

INTERSECTION DIAGRAM (Label Approaches)



INTERSECTION REF #

Peak Hour Volumes

APPROACH :	1	2	3	4	5	Total Entering Vehicles
DIRECTION :	NB	SB	EB	WB		
VOLUMES (AM/PM) :	0	15	522	648		1,185

" K " FACTOR : 0.090 APPROACH ADT : 13,167 ADT = TOTAL VOL/"K" FACT.

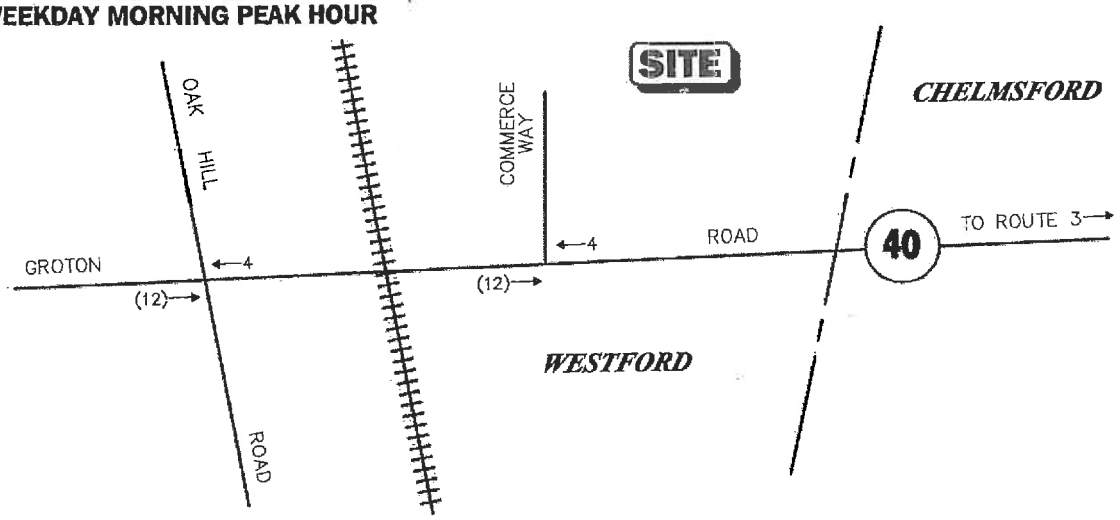
TOTAL # OF ACCIDENTS : 3 # OF YEARS : 5 AVERAGE # OF ACCIDENTS (A) : 0.60

CRASH RATE CALCULATION : 0.12 RATE = $\frac{(A * 1{,}000{,}000)}{(ADT * 365)}$

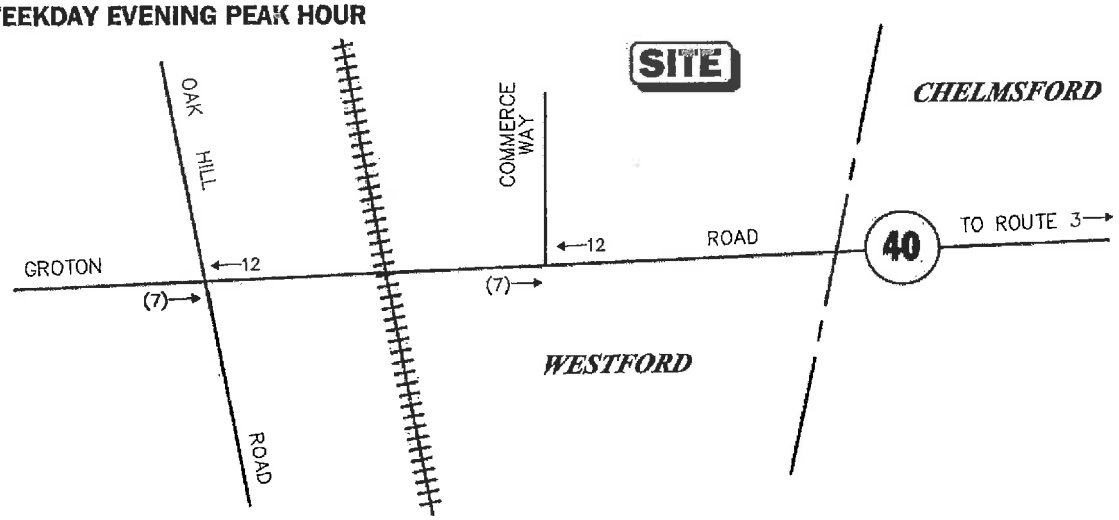
Comments : Crash rate is significant if > 0.58 crashes per mev for an unsignalized intersection for MassDOT District 3.

BACKGROUND DEVELOPMENT WORKSHEETS

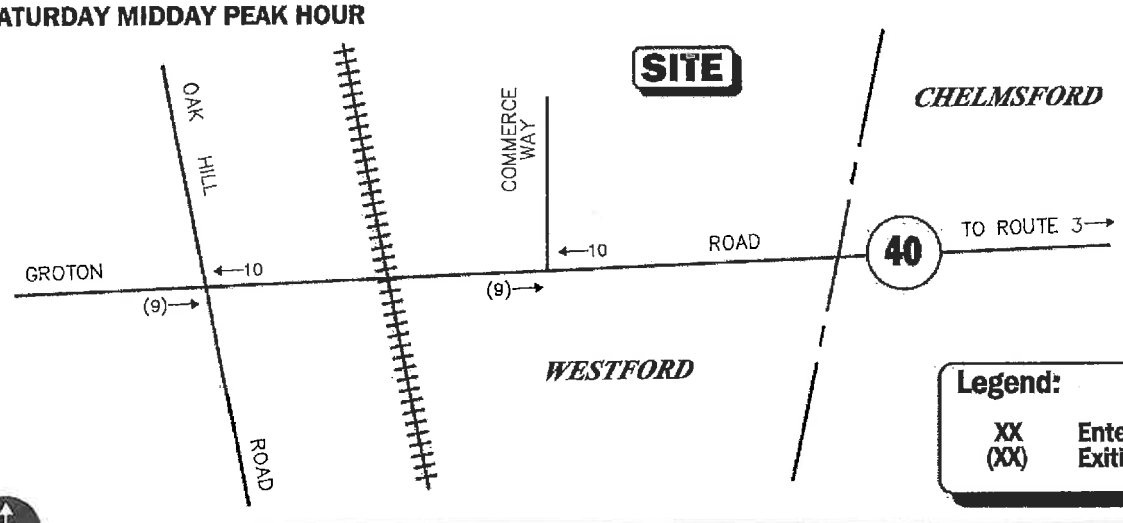
WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



SATURDAY MIDDAY PEAK HOUR



Legend:

XX	Entering Trips
(XX)	Exiting Trips

Not To Scale

Figure A-2

Vanasse & Associates, inc.

Background Development
Spaulding Estates
Peak Hour Traffic Volumes

GENERAL BACKGROUND TRAFFIC GROWTH

Table 4.1: Traffic Growth Trends for Major Roadways in the Northern Middlesex Region

Route	Town	MRPC ID	Location	First Count Year	AADT	Latest Count Year	AADT	Annual Growth Rate %	Total Growth (last vs. first years)
3	Tyngsborough	575	Route 3 @ New Hampshire State Line	2003	63,246	2013	86,453	3.67	36.69
3	Westford	657	Route 3 @ Tyngsborough T.L.	2003	77,328	2013	96,625	2.50	24.95
3	Chelmsford	144	Route 3 @ Lowell C.L.	2003	84,917	2013	108,548	2.78	27.83
3	Billerica	67	Route 3 @ Chelmsford T.L.	2005	91,400	2012	104,899	2.11	14.77
3	Billerica	68	Route 3 South of Concord Rd	2006	86,000	2012	95,209	1.78	10.71
3				2004	79,223	2013	99,131	2.87	25.13
3A	Tyngsborough	580	Frost Road @ New Hampshire State Line	2006	8,000	2012	6,700	-2.71	-16.25
3A	Tyngsborough	588	Middlesex Rd South of Westford Rd	2004	10,200	2010	7,200	-4.90	-29.41
3A	Chelmsford	107	Princeton Street @ Lowell C.L.	2006	5,100	2012	5,300	0.65	3.92
3A	Lowell	393	Westford Street @ Tyler Park (W of Florence Ave)	2003	7,900	2013	7,000	-1.14	-11.39
3A	Lowell	395	Westford Street West of Stevens Street	2004	7,700	2011	7,900	0.37	2.60
3A	Lowell	394	Westford Street West of School Street	2003	11,200	2012	12,157	0.95	8.54
3A	Billerica	82	Boston Road South of Concord Road	2005	21,800	2011	23,454	1.26	7.59
3A	Billerica	77	Boston Road North of Community Road	2004	22,100	2012	19,500	-1.47	-11.76
3A				2004	11,750	2012	11,151	-0.70	-5.09
4	Chelmsford	109	North Road North of Technology Drive	2005	12,100	2011	14,700	3.58	21.49
4				2005	12,100	2011	14,700	3.58	21.49
27	Chelmsford	142	Acton Road @ Westford T.L.	2003	3,800	2012	4,383	1.70	15.34
27	Westford	656	Acton Road @ Acton T.L.	2005	7,500	2011	7,100	-0.89	-5.33
27				2004	5,650	2012	5,742	0.22	1.62
38	Dracut	238	Bridge Street @ New Hampshire State Line	2003	12,000	2013	11,413	-0.49	-4.89
38	Lowell	380	Bridge Street North of VFW Highway	2003	19,200	2012	24,456	3.04	27.38
38	Lowell	382	Nesmith Street North of Merrimack Street	2003	31,700	2012	27,571	-1.45	-13.03
38	Lowell	384	Rogers Street North of Boylston Street	2004	29,900	2012	23,188	-2.81	-22.45
38	Tewksbury	524	Main Street South of I-495	2003	27,100	2012	32,858	2.36	21.25
38	Tewksbury	527	Main Street South of South Street	2003	14,100	2011	13,600	-0.44	-3.55
38				2003	22,333	2012	22,181	-0.08	-0.68
40	Chelmsford	157	Groton Road East of Route 3 NB	2004	7,200	2011	8,200	1.98	13.89
40	Chelmsford	156	Groton Road @ Westford T.L.	2003	12,100	2012	13,674	1.45	13.01
40	Westford	661	Groton Road West of Dunstable Road	2004	9,500	2011	9,400	-0.15	-1.05
40	Westford	665	Groton Road @ Groton T.L.	2003	4,000	2012	4,300	0.83	7.50
40				2004	8,200	2012	8,894	1.06	8.46
110	Dracut	200	Merrimack Avenue @ Methuen T.L.	2003	13,100	2012	13,100	0.00	0.00
110	Chelmsford	782	Chelmsford Street East of Golden Cove Road/Steadm	2007	14,400	2011	15,080	1.18	4.72
110	Chelmsford	133	Chelmsford Street North of I-495 Ramp	2004	13,100	2006	14,800	6.49	12.98
110	Chelmsford	139	Littleton Road @ Westford T.L.	2003	9,100	2012	8,300	-0.98	-8.79
110	Westford	636	Littleton Road @ Littleton T.L.	2003	13,300	2009	9,600	-4.64	-27.82
110				2004	12,600	2010	12,176	-0.56	-3.37

= Data averages.

TRIP-GENERATION CALCULATIONS

TRAFFIC ESTIMATION WORKSHEET
Proposed Manufacturing Facility
Route 140 - Westford, MA

Haulers

Daily Production:	1500 tons	Equival.			
10 Ton Trucks:	15%	1.5	94 tons/day	10	trucks/day
24 Ton Trucks:	60%	14.4	904 tons/day	38	trucks/day
32 Ton Trucks:	25%	8	502 tons/day	16	trucks/day
Total:	100%	23.9	1500 tons/day	64	trucks/day

Raw Materials

Daily Production:	1170 tons	Equival.	78% Materials Imported	from Off-Site	
10 Ton Trucks:	0%	0	0 tons/day	0	trucks/day
24 Ton Trucks:	0%	0	0 tons/day	0	trucks/day
32 Ton Trucks:	100%	32	1170 tons/day	37	trucks/day
Total:	100%	32	1170 tons/day	37	trucks/day

Recycled Asphalt Pavement (RAP)

Daily Production:	375 tons	Equival.	25% Materials Imported	from Off-Site	
30 Ton Trucks:	100%	30	375 tons/day	13	trucks/day
		30	375 tons/day	13	trucks/day

Total Daily Truck Traffic

Daily Production:	1500 tons	Entering	Exiting	Total
10 Ton Trucks:	10	10	10	20
24 Ton Trucks:	38	38	38	76
30 Ton Trucks:	13	13	13	26
32 Ton Trucks:	53	53	53	106
Diesel Fuel Trucks:	1	1	1	2
Liquid Asphalt Delivery:	2	2	2	4
Total:	**117**	**117**	**117**	**234**

Employee Traffic

Operational Hours: 6:00 AM to 7:00 PM		Entering	Exiting	Total
Number of Employees:	5	**8**	**8**	**16**

Total Traffic

Entering	Exiting	Total
125	**125**	**250**

TRAFFIC ESTIMATION WORKSHEET
Proposed Manufacturing Facility
Route 140 - Westford, MA

	Weekday Truck Traffic			Employee Traffic		
Time of Day	Entering	Exiting	Total	Entering	Exiting	Total
5:00 AM	0	0	0	1	0	1
6:00 AM	12	11	23	2	0	2
7:00 AM	17	18	35	2	0	2
8:00 AM	11	12	23	0	0	0
9:00 AM	12	11	23	0	0	0
10:00 AM	6	6	12	0	0	0
11:00 AM	6	6	12	0	0	0
12:00 PM	6	6	12	2	3	5
1:00 PM	6	6	12	1	0	1
2:00 PM	6	6	12	0	0	0
3:00 PM	11	12	23	0	0	0
4:00 PM	12	11	23	0	2	2
5:00 PM	6	6	12	0	2	2
6:00 PM	6	6	12	0	1	1
7:00 PM	0	0	0	0	0	0
Total	117	117	234	8	8	16

	Saturday Truck Traffic			Employee Traffic		
Time of Day	Entering	Exiting	Total	Entering	Exiting	Total
5:00 AM	0	0	0	1	0	1
6:00 AM	0	0	0	2	0	2
7:00 AM	17	18	35	2	0	2
8:00 AM	11	12	23	0	0	0
9:00 AM	12	11	23	0	0	0
10:00 AM	12	12	24	0	0	0
11:00 AM	12	12	24	0	0	0
12:00 PM	6	6	12	2	3	5
1:00 PM	6	6	12	1	0	1
2:00 PM	12	11	23	0	0	0
3:00 PM	11	12	23	0	0	0
4:00 PM	12	11	23	0	2	2
5:00 PM	6	6	12	0	2	2
6:00 PM	0	0	0	0	1	1
7:00 PM	0	0	0	0	0	0
Total	117	117	234	8	8	16

CAPACITY ANALYSIS WORKSHEETS

Groton Road (Route 40) at Oak Hill Road
Groton Road (Route 40) at Commerce Way (540 Groton Road)

Groton Road (Route 40) at Oak Hill Road

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	568	39	87	200	24	18	19	164	24	10	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	9	13	13	9	12	12	11	11	11	13	11	11
Storage Length (ft)	90		0	100		0	0		0	60		0
Storage Lanes	1		0	1		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.990			0.984			0.890			0.979	
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	1624	1926	0	1593	1804	0	0	1593	0	1865	1798	0
Flt Permitted	0.950			0.950				0.996		0.950		
Satd. Flow (perm)	1624	1926	0	1593	1804	0	0	1593	0	1865	1798	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		530			2025			378			287	
Travel Time (s)		12.0			46.0			8.6			6.5	
Peak Hour Factor	0.93	0.93	0.93	0.76	0.76	0.76	0.78	0.78	0.78	0.80	0.80	0.80
Heavy Vehicles (%)	0%	1%	0%	2%	3%	9%	6%	0%	2%	0%	0%	0%
Adj. Flow (vph)	5	611	42	114	263	32	23	24	210	30	13	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	5	653	0	114	295	0	0	257	0	30	14	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 65.9% ICU Level of Service C
Analysis Period (min) 15

Intersection	
Int Delay, s/veh	10.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	5	568	39	87	200	24	18	19	164
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None
Storage Length	90	-	-	100	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-
Peak Hour Factor	93	93	93	76	76	76	78	78	78
Heavy Vehicles, %	0	1	0	2	3	9	6	0	2
Mvmt Flow	5	611	42	114	263	32	23	24	210

Major/Minor	Major1			Major2			Minor1		
Conflicting Flow All	295	0	0	653	0	0	1157	1166	632
Stage 1	-	-	-	-	-	-	642	642	-
Stage 2	-	-	-	-	-	-	515	524	-
Critical Hdwy	4.1	-	-	4.12	-	-	7.16	6.5	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.16	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.16	5.5	-
Follow-up Hdwy	2.2	-	-	2.218	-	-	3.554	4	3.318
Pot Cap-1 Maneuver	1278	-	-	934	-	-	170	196	480
Stage 1	-	-	-	-	-	-	456	472	-
Stage 2	-	-	-	-	-	-	535	533	-
Platoon blocked, %		-	-		-	-			
Mov Cap-1 Maneuver	1278	-	-	934	-	-	145	171	480
Mov Cap-2 Maneuver	-	-	-	-	-	-	145	171	-
Stage 1	-	-	-	-	-	-	454	470	-
Stage 2	-	-	-	-	-	-	456	468	-

Approach	EB	WB	NB
HCM Control Delay, s	0.1	2.6	39.8
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	348	1278	-	-	934	-	-	67	195
HCM Lane V/C Ratio	0.74	0.004	-	-	0.123	-	-	0.448	0.077
HCM Control Delay (s)	39.8	7.8	-	-	9.4	-	-	96.5	25
HCM Lane LOS	E	A	-	-	A	-	-	F	D
HCM 95th %tile Q(veh)	5.7	0	-	-	0.4	-	-	1.8	0.2

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

PRINCIPALS
Robert J. Michaud, P.E.
Ronald D. Desrosiers, P.E., PTOE
Daniel J. Mills, P.E., PTOE

March 11, 2015

Ms. Chris Kluchman
Director of Land Use Mgmt.
Town of Westford
55 Main Street
Westford, MA 01886

Subject: Transportation Review Services
Proposed Asphalt Manufacturing Plant
540 Groton Road; Westford, MA

Dear Ms. Kluchman:

In accordance with our contract to conduct peer review services for the above-referenced project, MDM Transportation Consultants, Inc. (MDM) is pleased to provide you with the following comments. These comments have been prepared based on our field inspection of the site and study area and review of the documents identified below. The Town of Westford's "Guidelines for Preparation of a Transportation Impact Assessment" serve as a basis for our review; MDM also relies upon stipulations contained in the Remand Decision of the Land Court concerning the project[1] and associated testimony and supporting documents.

The submitted Transportation Impact Statement (TIS) for the current project generally conforms to the industry standards and the Town's TIA Guidelines, concluding that implementation of specific access improvements and ongoing traffic monitoring and reporting that the Project can be accommodated by existing transportation infrastructure. *This finding relies upon the Applicant's stipulated maximum daily two-way trip generation of 250 vehicle trips for the Project, consistent with the Remand Decision.* Given the potential for variability in actual Project trip generation due to factors such as the number, size, capacity and efficiency of vehicles making deliveries to and from the Site it is imperative that regular monitoring of Project trip activity occur to ensure these findings remain valid.

In summary MDM finds that the currently proposed Project, following implementation of proposed access mitigation measures and stipulated daily vehicle trip restrictions, will result in no notable detrimental capacity or queue impacts to travel on Groton Road or area roadways serving the site within Westford. This opinion rests on implementation of the following specific recommendations:

[1] Commonwealth of Massachusetts Land Court, Department of the Trial Court, 10 MISC 429867 (AHS), December 8, 2014.

- *Site Access.* The Applicant proposes geometric, pavement marking and traffic sign modifications to the site driveway at Commerce Way to improve driver guidance and minimize vehicle conflicts point as depicted on conceptual improvement plans prepared by Landtech Consultants dated February 11, 2013. Supporting truck turn analyses/diagrams for the proposed driveway layout prepared by VAI indicate areas of encroachment that will require modification/refinement of this conceptual plan to properly accommodate truck movements to/from the Site within available paved areas and marked lanes. MDM recommends that driveway modifications as depicted on the Landtech conceptual plan be formalized as an engineering document with specific lane dimensions, lane striping and sign placement that conforms to MUTCD standards for approval by the Town. Specific recommendations are cited under *Site Access/Egress and Circulation* comments below.

  MDM notes that the proposed circulation enhancements at the Site driveway are warranted independent of the proposed asphalt plant to improve driveway safety and driver guidance; implementation of these improvements will address existing Site operations as well as additional truck activity generated by the Site. To further enhance safety and efficiency of truck movements at the driveway, MDM recommends that the Applicant include widening Groton Road to increase the useable (paved) shoulder area on the eastbound approach to the driveway. This may be achieved by widening of Groton Road along the north edge and shifting the centerline to accommodate a wider shoulder area.

- *Advance Advisory/Warning Signs.* MDM recommends advance warning signs along Groton Road following MUTCD guidance ("Trucks Entering Ahead") in combination with 35 mph speed advisory plaques to alert motorists of truck activity and to encourage slower travel speeds in the Site vicinity. Applicant has committed to these improvements as cited in the submitted TIS.

- *Traffic Monitoring.* MDM advises that a monitoring program be developed and administered by the Applicant with regular (monthly) reporting to the Town to verify actual Project traffic generation. Such monitoring should include a certified summary of daily records of time-stamped trip activity logs (including all truck activity, employee activity and visitor activity associated with the Project), and would enable regular review of Project trip activity relative to projections. Instances where trip activity is documented to exceed the stipulated maximum daily trips may require additional mitigation including but not limited to police officer control to ensure efficient traffic operation at Groton Road.

Documents Reviewed

MDM has reviewed the following documents to gain an understanding of the project and determine if industry standards have been applied in determining the potential impacts of the project. The following relevant documents were reviewed:

- *Transportation Impact Assessment, Proposed Asphalt Manufacturing Facility, Westford, Massachusetts*, prepared by Vanasse & Associates (VAI) dated February 2015.
- *Site Plan, Asphalt Manufacturing Facility, 540 Groton Road (Route 40), Westford, Massachusetts*, prepared by LandTech Consultants, and dated December 31, 2014.
- *AutoTurn® Analysis and Exhibits*, Groton Road/Commerce Way Intersection prepared by VAI received March 2, 2015 (via email).

Project Description

The following key characteristics serve as the basis for determining Project traffic impacts, with clarifications noted:

1. *Facility Output.* Project impacts are based on an assumed average production of 1,500 tons of bituminous product per day with a restriction of generating no more than 250 vehicle trips per diem pursuant to stipulations in the Remand Decision of December 8, 2014. MDM interprets this facility output to mean that there may be days when higher amounts of product may be produced; however, associated Project trips are "capped" at 250 per day under any operating scenario, which are subject to regular monitoring and reporting.

2. *Employment/Scheduling.* The Applicant cites that at least five (5) employees will oversee manufacturing operations. MDM anticipates that shifts may be scheduled for the Project based on prior permitting efforts, cited previously to include a total employment level of up to 12 persons for all shifts. *Daily trip generation estimates to reflect total employment (if in excess of 5 staff assumed in the TIS) should be provided for clarification.*

3. *Truck Distribution.* The Applicant has stated its commitment to restricting larger trucks to "left-turn only" exiting the Site, consistent with current practice. Trucks with local destinations (local paving contractors) that require right-turn egress will be managed by a color-coded ticket procedure that allows enforcement by local police.

4. *Emergency Access Easement.* A 20-foot wide emergency access easement is depicted on the Site Plans; design details of this easement are not provided and MDM explicitly assumes that such easement will be maintained as a gated/controlled easement with

appropriate design details to be provided to the Town in subsequent design submittals by the Applicant.

Study Area

The TIS evaluates traffic impacts for the intersections of Groton Road with Commerce Way (the Site driveway) and with Oak Hill Road – an intersection that is planned to be improved by the Town with state funding under the 2015-2018 Transportation Improvement Program (TIP). These locations are appropriate and consistent with our prior recommended study intersections; no further comment necessary.

Existing Traffic Volumes

The TIS documents peak hour and daily traffic counts for a seasonally-adjusted average weekday. The existing conditions data are generally consistent with prior (2009) traffic volume data reviewed by MDM for study intersections. However, traffic volumes to/from Commerce Way have been adjusted (increased) in the TIS to reflect estimated summertime activity levels associated with existing materials processing operations at the property.

As a point of reference, MDM understands that the existing materials processing operations at the property is subject to a 2009 Board of Appeals Decision that limits daily truck generation to 75 truckloads of material (150 total truck-trips of material entering and exiting the property). Other uses within the subject property served by Commerce Way include an area dedicated to retail sales of finished granite products (curbs, etc.), a solar farm which requires periodic maintenance, and a mostly vacant office building. Adjusted trips to/from Commerce Way as documented in the TIS are substantially higher than surveyed in March 2009 (17 vehicle trips total AM peak hour) when these uses were in operation, representing approximately 61 trips during the weekday AM peak hour. Consequently, it is the opinion of MDM that the trip adjustment for Commerce Way is conservatively high.

In summary, MDM finds that the existing conditions data presented in the TIS are generally appropriate for impact analysis purposes. However the Commerce Way volumes should not be construed to represent an accurate "baseline" of trip activity for the existing materials processing or other existing uses at the property; this "No Build" baseline should be validated by the Applicant using actual data for a typical weekday and Saturday operations prior to operations of the asphalt manufacturing plant and associated traffic monitoring for that facility.

Vehicle Speeds & Sight Distance

Measured 85th percentile travel speeds are reported at up to 42 mph and exceed the posted regulatory speed limit of 35 mph. Prior travel speed data for Groton Road for a non-winter period (March 2009) indicate 85th percentile travel speeds of up to 50 mph. The TIS cites that available sight lines at the Commerce Way intersection exceed 650 feet, which exceeds criteria for a 50 mph travel speed. Field measurements by MDM confirm that there is an available sight line of more than 650 feet on the approaches to the Site driveway, which allows ample travel time to perceive and react to (slow down or stop) truck activity at the Site drive.

MDM recommends that the design for Commerce Way driveway improvements restrict structures and plantings to 2 feet above grade or less within fifteen feet (15') of the curb line on Groton Road to ensure that the proposed landscape plantings do not restrict sight distance.

Crash History

The TIS presents the latest available MassDOT crash database records for the period 2008-2012 indicating crash rates at Commerce Way are well below statewide and District 3 crash rates. This is consistent with local records for the latest 5-year period cited by the Westford Police Department which indicate 3 crashes at or near the Commerce Way intersection.

The crash rate at Oak Hill Road is substantially higher than average and this intersection is listed as in the top 100 high crash locations for 2006-2008 in the Northern Middlesex region. Planned/programmed improvements at Oak Hill Road under the 2015-2018 TIP are expected to address safety deficiencies at this location.

The Applicant proposes driveway modifications that will reduce vehicle conflict points at Commerce Way and/or that will enhance truck maneuvering. Advance warning signs along Groton Road advising motorists of truck activity are also proposed. These measures are expected to enhance travel safety at Commerce Way and are appropriate given the anticipated increase in truck trip activity generated by the Project.

Future No Build Traffic Conditions

Future (7-year horizon) traffic volumes are projected using a 1.5 percent annualized growth factor, plus traffic for known/planned area development identified in consultation with the Town of Chelmsford and Town of Westford. MDM finds that use of a 7-year horizon is conservative (the Town TIS Guidelines require a 5-year horizon), and that the 1.5 percent annualized growth rate is supported by historic count data/growth trends published by the

regional planning authority (NMCOG). Direct comparison of 2009 and 2015 (seasonally adjusted) traffic data for Groton Road also supports the use of this growth rate.

The Future year conditions also anticipate completion of improvements at Oak Hill Road, which is listed on the 2015-2018 TIP; MDM finds this acceptable and consistent with industry practice.

Project Trip Generation

The Applicant has presented trip generation scenarios based on projected vehicle fleet, employment levels and projected hourly patterns. The Applicant's projected peak hour trip generation under the stated average production of 1,500 tons of asphalt per day is 250 vehicle trips per day (125 vehicle entering and 125 vehicle exiting), consistent with the Remand Decision limiting the daily trip activity from the Project to this amount. The projected peak hour totals under this scenario are less than 40 vehicle-trips.

Given the potential for variability in actual Project trip generation due to factors such as the number, size, capacity and efficiency of vehicles making deliveries to and from the Site it is imperative that regular monitoring of Project trip activity occur to ensure these stipulated trip limits are reasonably achieved and to validate actual performance of the Project as cited under *Recommendations* below.

Trip Distribution and Assignment

Traffic data for the existing Site supports the Applicant's trip distribution patterns, notably the predominant distribution of trips to/from the east. The Applicant also proposes to restrict truck turns exiting the site to left-turns, consistent with current practice at the Site drive. Occasional right-turn activity is likely for contractors with local destinations (estimated by the Applicant to be 5 percent of all trips made from the Site). The Applicant proposes a ticketing system under which trucks with local destinations (local paving contractors) that require right-turn egress will be issued a coded ticket that allows enforcement of non-authorized trucks by local police.

MDM concurs with the trip distribution and assignment presented in the TIS and acknowledges Applicant's commitment to minimize impacts west of the Site by use of a ticketing procedure for local truck deliveries.

Traffic Operations Analysis

The TIS presents capacity and vehicle queue analyses for the Commerce Way and Oak Hill Road intersections that are prepared in conformance with industry protocols and that follow Town TIS Guidelines. MDM concurs with the analysis results and makes the following general observations:

- Traffic flow on Groton Road in the Site vicinity is generally unimpeded with LOS A conditions (minimal average delay).

- Left-turn egress from the Site onto Groton Road is subject to longer delays (LOS E/F conditions during AM and PM peak hours); however, vehicle queues are manageable and represent between 2 and 4 vehicles during peak conditions. Modification of driveway layout is recommended to enhance operating efficiency and safety as noted under Site Access/Egress and Circulation.

- Operations at Oak Hill Road are generally unimpeded for the Groton Road approaches; however, the Oak Hill Road approaches are subject to longer delays (LOS F) and queuing. Planned improvements will include signalizing this intersection, which result in improved operations (LOS B or better). Incremental impact of the Site traffic are inconsequential under peak operating scenarios presented in the TIS.

In summary, traffic operations along Groton Road are below capacity and are projected to remain so with the proposed Project in operation. Notable delays for the Commerce Way approach to Groton Road are projected; however, associated vehicle queues will not impact public travel and will be reasonably accommodated within the Site. MDM concurs with the analysis findings, but explicitly notes that the analysis results are premised on a projected "baseline" of trip activity for existing Site uses that should be validated under typical operating conditions during the traffic monitoring phase of the Project. Trip activity above that specified in the No Build traffic volume networks for Commerce Way would results in additional delays/queuing that may require additional mitigation measures.

Site Circulation

The submitted Site Plan is consistent with the plans previously submitted for review by LandTech (10/30/09) for which a truck turn analysis using AutoTURN® software confirms site circulation aisles can adequately accommodate the largest truck anticipated to access the facility, including Town emergency (fire) apparatus.

Recommendations

Driveway Design. The Applicant proposes geometric, pavement marking and traffic sign modifications to the site driveway at Commerce Way to improve driver guidance and minimize vehicle conflicts point as depicted on conceptual improvement plans prepared by Landtech Consultants dated February 11, 2013. Supporting truck turn analyses/diagrams for the proposed driveway layout prepared by VAI indicate areas of encroachment that will require modification/refinement of this conceptual plan to properly accommodate truck movements to/from the Site within available paved areas and marked lanes. MDM recommends that driveway modifications as depicted on the Landtech conceptual plan be formalized as an engineering document with specific lane dimensions, lane striping and sign placement that conforms to MUTCD standards for approval by the Town.

MDM notes that the proposed circulation enhancements at the Site driveway are warranted independent of the proposed asphalt plant to improve driveway safety and driver guidance; implementation of these improvements will address existing Site operations as well as additional truck activity generated by the Site. MDM further recommends that the Planning Board require the Applicant to provide a 4 foot widening of Groton Road to further facilitate left-turn egress from the Site, subject to applicable local permitting. One potential means of achieving this is a widening of the shoulder area on the North side of Groton Road, allowing the centerline to be shifted north to create a more generous shoulder for the eastbound approach to the driveway. The wider eastbound approach would facilitate wider (left-turn) truck sweeps from the driveway, thereby improving the efficiency of these turns while also minimizing potential encroachment onto the opposing (westbound) travel lane. This widening would also provide a roadway cross section that allows for bicycle travel in a shared travelled-way configuration (minimum 28 foot roadway width) that is consistent with other portions of Groton Road.

Advance Advisory/Warning Signs. MDM recommends advance warning signs along Groton Road following MUTCD guidance ("Trucks Entering Ahead") in combination with 35 mph speed advisory plaques to alert motorists of truck activity and to encourage slower travel speeds in the Site vicinity. Applicant has committed to these improvements as cited in the submitted TIS.

Traffic Monitoring. MDM advises that a monitoring program be developed and administered by the Applicant with regular (monthly) reporting to the Town to verify actual Project traffic generation. Such monitoring should include a summary of daily records of time-stamped trip activity logs (including all truck activity by type, employee activity and visitor activity associated with the Project), and would enable regular review of Project trip activity relative to projections. Instances where trip activity is documented to exceed the stipulated maximum daily trips may require additional mitigation including but not limited to police officer control

to ensure efficient traffic operation at Groton Road. Specific provisions of the monitoring program should consider the following, subject to refinement in further consultation with the Town and Applicant:

- **Baseline Trip Survey.** Applicant should establish an appropriate "baseline" survey of vehicle trip activity (by vehicle type) at Commerce Way independent of the Project to reflect the range of peak hour and daily trips generated by existing established uses on the Site including the materials processing facility, retail granite product sales, solar farm, and office use. The survey period should be representative of peak operating seasons for these uses (most likely summertime) and should include counts over a multi-day period to include weekdays and Saturdays. The combination of existing uses should generate peak hour trip levels that are equal to or less than those assumed in the TIS; significant variation from these estimates would raise concern regarding traffic operations once the Project becomes operational. The survey will also facilitate measurement of actual trip increases at Commerce Way that are attributed to the Project following opening.

- **Driveway Traffic Counts.** Turning movement counts (TMCs) for the Commerce Way driveway should be conducted following operation of the Project under peak season conditions over a multi-day period to include weekdays and Saturdays to validate projected Build traffic volume conditions used in the TIS. These TMCs would augment the vehicle activity logs maintained by the Applicant to validate peak driveway volumes, vehicle types and directional distribution of trips at Commerce Way under peak operating conditions.

- **Video Monitoring.** Town may wish to consider video-based traffic monitoring of Commerce Way to augment trip activity logs and "peak season" TMC data, which would allow real-time checks of driveway operations, trip levels and patterns relative to log reports and the established "Build" condition traffic projections cited in the TIS.

MDM notes that the above monitoring framework is intended to facilitate discussions with the Planning Board and Applicant and may be refined to include specific requirements including trip monitoring time periods/duration, format and certification requirements for logged trip activity and reporting and video monitoring protocols.

We appreciate the opportunity to provide Transportation Planning & Engineering Services to the Town of Westford. If you have any questions or concerns, please feel free to contact this office.

Very Truly Yours,

Robert J. Michaud, P.E.
Managing Principal

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March 30, 2015

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Town of Westford
Board of Selectmen
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RE: Application pursuant to Remand by Land Court in Newport Materials, et al v. Planning Board of Westford, et al., 10 Misc. 529867 (AHS)

Dear Members of the Planning Board, Zoning Board of Appeals and Board of Selectmen:

I am writing to you to object to the Town's excessive use of the litigation exception to the MA Open Meeting Law, G.L.c. 30A, 21(a)(3). To date, the Town has held 7 executive sessions, purportedly to "discuss strategy with respect to litigation". The sessions began on December 23, 2014 with a joint session of the Board of Selectmen and the Planning Board, which was followed on January 8, 2015 with a joint session of the Planning and Zoning Board of Appeals. These joint sessions were followed by an additional 4 executive sessions before every session of the Planning Board that dealt with this matter and 1 with the Zoning Board of Appeals. An additional 2 executive sessions with the Planning Board were scheduled but cancelled due to snow storms. See attached list.

We believe these closed sessions are highly irregular, totally unnecessary, inconsistent with the Open Meeting Law and in direct contravention of Judge Sands' directive on page 32 of his decision, strongly encouraging the parties to maintain "an active and *open* dialogue" (emphasis added) throughout the resubmission process. We also believe they have adversely affected my client's due process rights.

These secret sessions are a disservice to the public and to my client and should cease immediately, although I fear the damage may have already been done. In addition, the minutes of each session should be prepared and held aside for potential in camera review by the Court. A litigation hold should also be placed on any notes, emails and other materials related to the listed executive sessions.

Sincerely,

Thomas F. Reilly

TFR/aaa
#1394202v2

List of Executive Sessions

1. 12/23/14 - JOINT Selectmen and Planning Boards
2. 1/8/15 - JOINT ZBA and Planning Boards
3. 1/21/15 - Planning Board
4. 1/26/15 - Planning Board-- Cancelled SNOW
5. 2/2/15 - Planning Board-- Cancelled SNOW
6. 2/12/15 - Planning Board
7. 2/25/15 - Zoning Board of Appeals
8. 3/2/15 - Planning Board
9. 3/16/15 - Planning Board